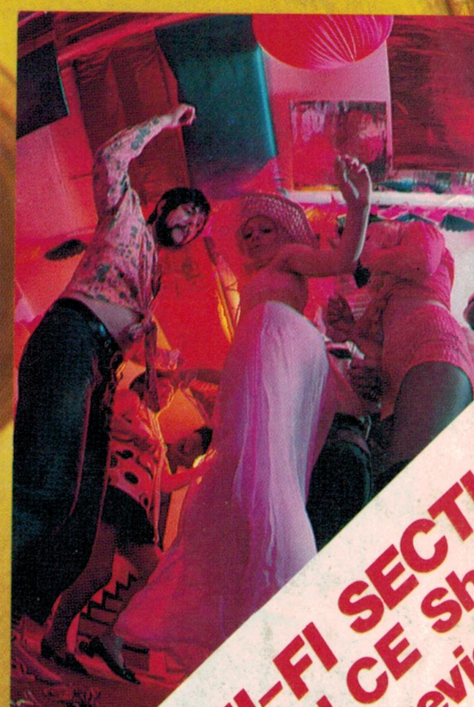
Sept 1979
$1·40* NZ $1.60

eti ELECTRONICS TODAY INTERNATIONAL



DISCO STROBE to build

Relax—with biofeedback

Artificial intelligence —how close?

Satellite navigation system explained

GREAT NEW HI-FI SECTION includes special CE Show report, plus top reviews

A new dynamic generation of Maxell tapes.

When Maxell announces an improvement in the quality of its tape, you can bet the improvement has to be pretty dynamic. In fact, we think our new generation has even gone beyond our own standards of superior sound reproduction.

Take our high level (CrO_2) position tape — the UD-XL II. Maxell engineers have succeeded in expanding its dynamic range in the middle-low frequency range by 1 dB, while also pushing its sensitivity by 1 dB in the high frequency range. Then look at our normal position UD-XL I, UD and LN tapes — our engineers expanded the dynamic range at all frequency points, while also boosting output in the high frequency range. The new dynamic range, of course, allows for better music reproduction even for LN-type tapes.

On the UD-XL I and II, we also added an exclusive shell stabilizer for significantly improved tape running and track positioning.

One thing hasn't changed on all Maxell tapes — our functional features like 4-function leader tape, replaceable index labels for UD-XL series tapes and Maxell's through-production system — your guarantee of quality and superior sound reproduction.

Tape selector position UD-XL I, UD, LN: Normal position (Normal bias/120 μsec. EQ)
UD-XL II: High level position (High level bias/70 μsec. EQ)

For details on all Maxell Recording Tape write to
Maxell Advisory Service, P.O. Box 307, North Ryde, N.S.W. 2113

Available time length UD-XL I: 60, 90 min./UD-XL II: 60, 90 min.
UD: 60, 90, 120 min./LN: 60, 90, 120 min.

Distributed by...
HAGEMEYER

maxell®
simply excellent

WT126/79

Registered for posting as a publication — Category B

ELECTRONICS TODAY INTERNATIONAL

Contents

THIS MONTH we have very nearly a 'something for everyone' issue. Our features run the gamut from space technology in navigation (about the **NAVSTAR** Global Positioning System), through **Biofeedback — a bridge to bionics** to **Artificial Intelligence** . Our lead project this month is an **electromyogram,** a device that detects the minute electrical impulses from muscles and provides a visual and audible output for biofeedback use. This is such an unusual project, employing some very interesting circuit techniques, that we have decided to devote more space than usual to describing it.

The project featured on our cover is the **Disco Strobe** an update on one of our all-time popular projects. Tom Moffat continues this month with the second part of how to **Get going on radio-teletype.** This month it's the transmitter modulator. For the keen amateur or shortwave listener we also have a **Versatile antenna tuner** for the 1.5 — 7 MHz band.

On the hi-fi front, we have a scoop review of the brilliant new **Nakamichi cassette deck** — the 680. Surprise, surprise . . . . we've reviewed a **Dick Smith cassette deck** too. Don't laugh!, there's real value for money there. The **Fourth CE Show** was a real eye-opener . . . you can ogle all the goodies in our **CE Show highlights** starting page 140.

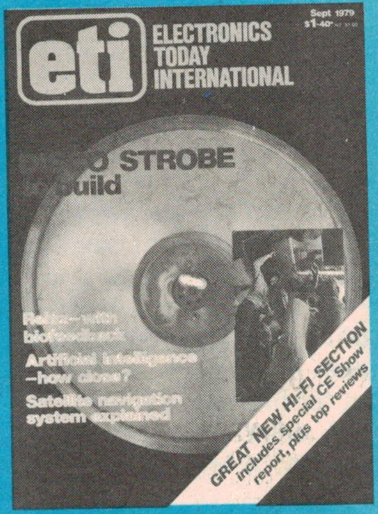
As the show spruiker said, "It's all on the inside!".

Roger Harrison, Editor

Roger Harrison

advertisers

eti ELECTRONICS TODAY INTERNATIONAL



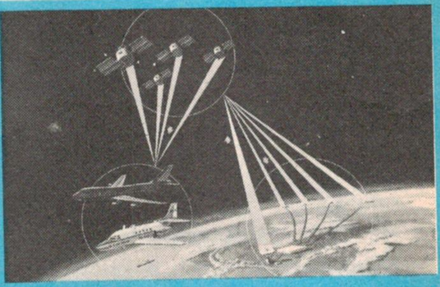
COVER

With the current popularity of disco music and the dance craze — complete with special lighting effects, demand for a strobe has been high. If you have disco at your parties or are called on to provide the effects at a local dance, then our disco strobe project should suit your requirements.

Again, the cover is by Ivy Hansen (inset picture of dancers from the Fritz Prenzel studio).

news

features

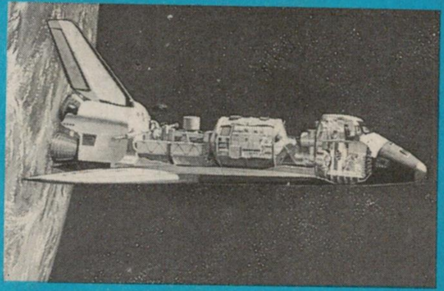


projects

sound

general

next month

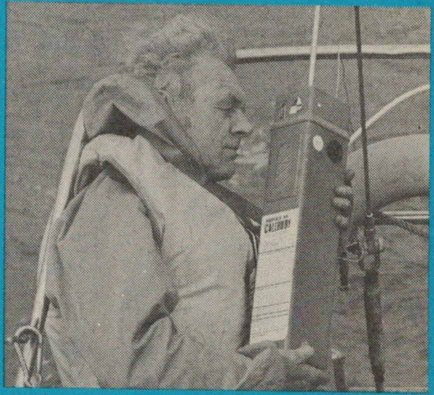


SPACELAB
A re-usable orbital vehicle, Spacelab is being readied for its first flight scheduled for the middle of next year. Its first mission will carry 76 scientific and technological experiments from European, American and Japanese agencies. Results are likely to have a profound effect on the development of science and technology into the next century.

IMPROVE YOUR HI FI SOUND WITHOUT DEPLETING YOUR WALLET
You can improve the dynamic range of your system by carefully optimising cartridge adjustments on your record player. A wholly practical guide to how it's done by Allen Wright and Rowan McCombe of Audiolab.

THE ARA665 AMPLIFIER FROM AUDIO REFLEX
A recent release from a local firm, this amplifier boasts low THD and a host of facilities and features that should appeal to the enthusiast.

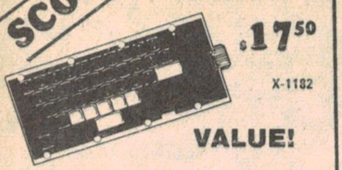
SERIES 4000 MOVING-COIL CARTRIDGE PREAMP
Designed by David Tilbrook, this unit is another in our "Series 4000" line of hi-fi projects and features superb performance – equal to the best available commercial units.



MARINE ELECTRONICS
A simple voyage in your own boat is no longer the 'by guess and by God' adventure it once was. These days there are a host of technological aids – mostly electronic. This feature gives a review of everything from electronic anemometers to ultrasonic depth sounders.

Although these articles are in an advanced state of preparation circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

SCOOP!!! VIDEO BRAIN



$17.50

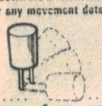
X-1182

VALUE!

'VIDEO BRAIN' COMPUTER KEYBOARD Full function computer style keyboard with 37 keys, silver plated double sided board, double sided edge connector (0.1" spacing) and high quality computer-grade push buttons with interchangeable key tops.
The manufacturer of this quality keyboard went broke and we bought the lot. You reap the benefit! This keyboard must have cost twice as much to manufacture as the price we're asking for it! All keys can be individually accessed by cutting PCB tracks. Come on all you experimenters: you've been asking for this — so here it is! Cat X-1182

PLASTIC ENCAPSULATED MERCURY SWITCH

By changing the position of this 'movement detection switch' a ball of mercury will run down the internal tube and 'make' with the two contacts. Ideal for any movement detector devices i.e. car burglar alarms.



$1

S-1035 .... $1.00
Buy 10 or more and pay only 75¢ each!

ZAPP!! ZAPP!! ZIPPY BOX TIME

150x90x50mm
H-2751 $2.50
196x113x60mm
H-2752 $3.75
130x68x41mm
H-2753 $1.95
83x54x28mm
H-2755 $1.50

● Very tough ● Moulded corner posts take self tappers ● Complete with covers ● 4 different sizes ● Ideal for projects

SPECIAL OF THE MONTH FOR TV VIEWERS . . .

Here's good news for anyone who watches TV - and isn't that just about everyone? Improve your picture quality with a Dick Smith Masthead Amplifier kit. Easy to build (uses a single hybrid integrated circuit) and simple to install, the masthead amplifier can turn an unwatchable mess into a brilliant picture. (Yes, we've actually seen it demonstrated!)

WHY PUT UP WITH POOR RECEPTION ANY LONGER: THE DIFFERENCE IS INCREDIBLE!

The masthead amplifier kit is complete (power supply included) and comes ready to assemble with full instructions. And now is the time to build it. **You save nearly 10% for this month only!** Hurry while stocks last.

~~$32~~ NOW ONLY $29.50

Cat K-3230

SPACE PROBLEMS?

Not enough room for you hi fi speakers? And you don't want those tiny ones because they're all junk? NOT ANY MORE! These new mini hi-fi speakers from Dick Smith have to be heard to be believed! Although they measure only a tiny 120 x 120 x 190mm, their performance is right up there with the big guns. And they compare favourably with speakers costing twice and three times as much! So if you are a little pressed for space, have a look and a listen to these. Consider the possibilities:

DUE EARLY SEPTEMBER

- Cars
- Caravans
- Boats
- Home Units & Flats
- Demonstrations
- Etc. etc etc . . .

$99.50

A-2375

SCOOP PURCHASE

SAVE $5.50

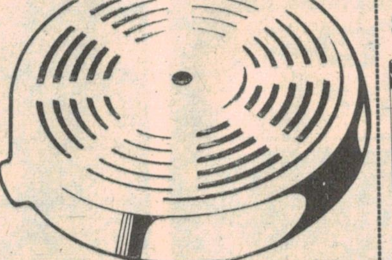
WAS $35

NOW ONLY

$29.50

L-5258

SMOKE DETECTOR



Loss of life due to smoke inhalation is increasing each year - PROTECT YOUR FAMILY NOW with the Dick Smith Smoke Detector. Simple to install, it requires the placing of two screws (supplied), and runs on a 9V DC battery (supplied). At the first hint of smoke a powerful alarm sounds giving you and your family more time to counter the cause of the smoke. Ideal for office and factory use too!

PROTECT YOUR PROPERTY AND YOUR FAMILY

ASK FOR A DEMO IN ANY OF THE DICK SMITH STORES

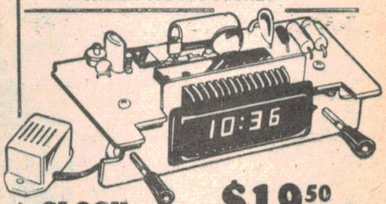
AC BRIDGE AND SPOT OSCILLATOR

*HIGH ACCURACY
*MEASURES OVER WIDE FREQUENCY RANGE
*LOGICAL DESIGN ENSURES EASE OF OPERATION
*DETAILED INSTRUCTIONS WITH EXAMPLES

$79.50

Accurately measure inductance (1uH - 111H), Capacitance (10pF - 1110uF), resistance (0.1 - 11.1Mohms), transformer turns ratio (1/10,000 - 1). Mainframe has a measuring frequency of 1kHz and the spot oscillator gives the following external frequencies 120, 300, 1kHz, 3kHz, 10kHz and 30kHz. Dimensions of mainframe 215x135x70mm & spot oscillator 120x80x55mm.
Q-1420 $79.50

THE LITTLE BIG SOUND!



CLOCK MODULE

$19.50

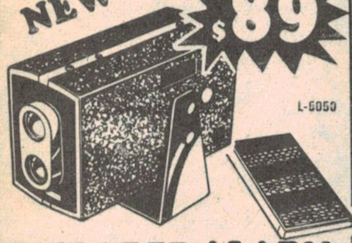
Complete electronics for easy installation into your car, boat or plane. Bright green gas-discharge display. It even has an alarm with solid state buzzer. Instructions include details on conversion of module to read 24 hours, give seconds display & for use as a stopwatch. Accuracy is controlled by a quartz crystal.

X-1045 $19.50
X-1047 with case and mounting hardware $24.50

NEW

$89

L-5050



INFRARED ALARM

SENSATIONAL NEW ALARM SYSTEM - Infrared photoelectric relay system with projector and receiver in one case. Easy to install - simply stick reflector panel opposite the infrared unit and any person cutting the invisible beam will set the alarm off. The alarm can be a buzzer, siren or lamp connected to the 12V DC 1A (max). output of the infrared unit. Can also be used as a counter - to check number of visitors or count items on a conveyor system. Includes sensitivity control, three position alarm setting and has an effective coverage of 0.8 to 15 metres. Dimensions: 90(w)x145(h)x190(d)mm. Weight 1.55kg.

HUGE SCOOP PURCHASE

AM TUNER MODULE

$5.95

TUNING GANG WORTH $5.95 ALONE !!!!

This SCOOP PURCHASE AM tuner module was used in a complete AM tuner that sold for $58!!!!!
The unit requires only 6V DC power supply and will drive most stereo amplifiers to full output. It can also be used as a portable if connected to a small amplifier. The ferrite rod antenna is mounted onboard for ease of installation in a case. Frequency range of 546 - 1653kHz and a sensitivity of 100uV (100% modulation) - top features at a **YOU REAP THE BENEFIT** price! F-4612

TOP VALUE

$54.50

34 RANGE MULTITESTER

A must for the serious electronics enthusiast's workbench is the multitester. NOT just any multitester BUT the Dick Smith combined multimeter and transistor tester. ● 100k ohms/V ● 34 ranges ● DCV from 0.5 to 1000V ● ACV from 5 to 1000V ● AC current 10A ● DC current from 10uA to 10A ● Resistance from 20 ohms to 200k (centre scale) ● Decibels −10 to +62dB ● Transistor h_{FE} 0-500, I_{CO} 0-50uA ● Protected movement ● Includes test leads, batteries and manual.
Q-1136 $54.50

TOOLS

for the enthusiast

MINI FLAT NOSE PLIER

Positive grip from the flat nose & a sure grip from the plastic coated handles. Length 100mm
T-3560. . . . . . $3.75

$3.75

$5.75

SLANT EDGE NIPPER

Box joint construction for absolute rigidity. Ideal for all electronic and electrical use. Length 125mm.
T-3210. . . . . . $5.75

COMBINATION PLIER

Sliding type jaw, for firm and positive grip. Every tool box should have one. Length 150mm.
T-3280. . . . . . $3.00

$3

$3.95

PRECISION PHILIPS 4pce SET.

Precision machined for use with dress Philips screws. i.e. front panel work.
Sizes: 0, 1, 1 (large) & 2.
T-4355. . . . . . $3.95

OMRON DPDT PCB RELAY

ONLY $3.50 INCREDIBLE VALUE

Cat. S-7135

Just look at this superb relay bargain - rated at 12V DC with a coil resistance of 290 ohms and a massive 0.4A contact rating. Mounts directly onto the PC board - ideal for modern circuits requiring a small relay.

SAVE 20%

Famous 'Weller' cordless soldering iron

YES! This top name Weller cordless iron is still at a fantastically low price! In-built re-chargeable cells give hours of soldering away from a power source. A built-in light shows the way in dark corners.
Mains charger and one spare tip included.

$26.00

FANTASTIC SAVING.... ~~$32.50~~ value!

INCLUDES MAINS CHARGER AND SPARE TIP • 12 MONTH GUARANTEE Cat T-1050
RANGE OF SPARE TIPS IN STOCK !

MINI DIL SWITCH

8 x SPST switches mounted in a single DIL package. Ideal for circuits where parameters may need alteration. Ideal for PCB mounting.
Cat S-1608 $2.75
ALSO AVAILABLE:
4 pin version of above. But you'd better hurry: stocks of these are limited!
4-way Cat S-1604 $1.85

RECTANGULAR LEDS!

Give your projects that real pro look with these smart rectangular leds. Available in red or green

RED Cat Z-4040 GREEN Cat Z-4042

65¢ each

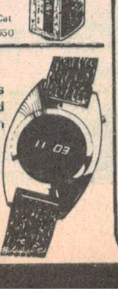
(55¢ each for 10 or more)

PROFESSIONAL PANEL METERS

Top quality type MRA 45B meters that will enhance any project requiring a meter. Overall size: 58(w)x52(h)mm. Hole required 44mm.

VU - (0dB = 1mW into 600 ohms) - 1000 ohms
Q-2050 ONLY $6.90
0 - 1mA - 120 ohms
Q-2010 $8.50 each
Buy 10 or more $7.50 each.
0 - 5A DC - 3 ohm shunt
Q-2030 $8.50 each
Buy 10 or more $7.50 each

LED WATCH



Hundreds of these digital watches have been scoop purchased and now we're selling them for less than $10.00

$9.95

- Full function digital watch
- Shows day, date, hours, mins, secs
- Complete with battery and strap
- Highly accurate

Cat: X-1041

PARTS/COMPONENTS CASES

Ideal for all of those 'bits & pieces' laying around on your workbench. Large case (H-25960) has two tiers of trays plus one extra deep tray (size overall: 290(l)x220(w)x45(d)mm). The smaller case (H-2594) has one tier of two lift out trays (size overall: 255(l)x180(w)x40(d)mm).

H-2596 $16.95
H-2594 $12.95

LCD 3½ DIGIT PANEL METER EVALUATION KIT

INTERSIL

ICL 7106 EV/Kit for LCD Displays

$39.50

This evaluation kit contains the ICL 7106 monolithic chip and is presented so that you can make up a very accurate digital voltmeter with automatic zero connection and automatic polarity.
KIT CONTAINS: ■ PC board & hardware ■ A/D converter ■ LCD display ■ Resistors ■ Capacitors ■ Wiring diagram ■ Application notes ■ Data sheet.

K-3450

NEWS digest

Jupiter: Voyager encounters enormous temperatures

The hottest place in the Solar System may well be in Jupiter's magnetosphere. Voyager I measured a temperature of 300 million degrees Kelvin at a point about 4.9 million kilometres from the planet.

Analysis of the plasma present in this region showed that it was mainly hydrogen, helium, oxygen and sulphur, the latter having a probable volcanic origin.

Jupiter's largest satellite, Ganymede, was also the subject of close scrutiny — the low density of this body means that it is probably made up of 50% water. Callisto, lightly smaller than Ganymede, may also have much the same composition.

Io is a strong contender for the strangest object in the solar system.

Slightly larger than our Moon, it shows no signs of cratering, and it is believed that it is completely re-surfaced every 10 million years or so by the strong volcanic activity of the moon — one of the surprises of the Voyager mission.

The high sulphur content of the volcanic gasses would also account for the wide range of colours — varying from red, through brown and grey to near-white — which cover the surface.

Briefs

Doped polyacetate, a new plastic which conducts electricity, has many possible applications as it can be given a specific amount of resistance. It has been suggested for application in electric blanket heating elements among other things. It is a non-corroding material.

Matsushita, in the wake of the recent political upheavals in Zaire where many of the World's cobalt mines are located, have produced a material which could replace cobalt in permanent magnets. The material is a mixture of manganese, aluminium and carbon and will hold thirty per cent more magnetic energy than the same weight of cobalt magnet.

Scientists working for Bell Laboratories have succeeded in creating a regular array of electrons similar in structure to a solid crystal. The technique may prove useful in accurately assessing various constants required in nuclear physics.

Researchers at the University of Rochester in the US have developed a method of taking X-ray 'flash' pictures by firing a laser at a sheet of plastic which emits X-rays as it disintegrates.

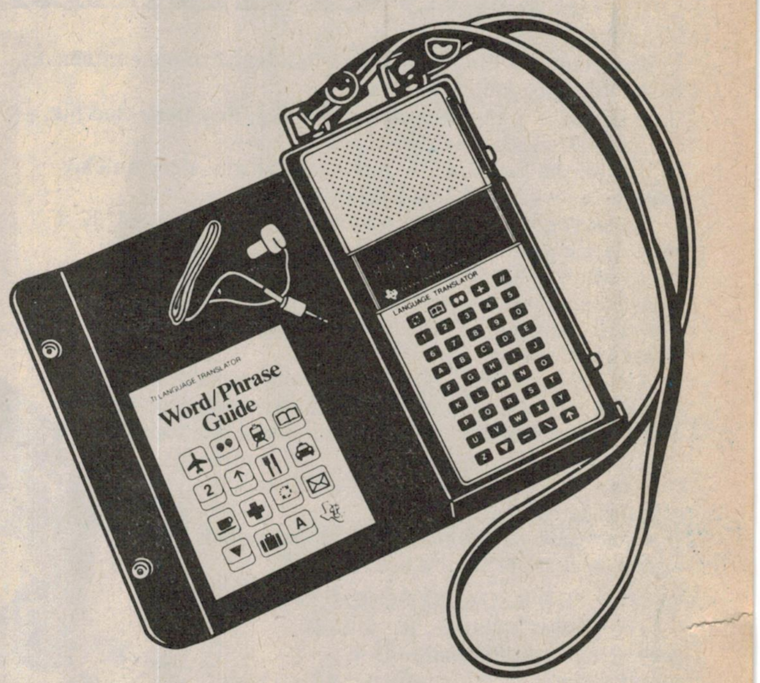
Owing to a clerical/programming error, phone subscribers in California received a credit for US $10186.65 each. This was quickly spotted and corrected (**after** the bills had been received) by the Pacific Telephone Co.

The French Ministry of Education plan to instal 10 000 computers in high schools over the next ten years as part of a move to increase computer literacy.

Engineers at Siemens have modulated a Helium-Neon laser to 100 percent using a special resonator geometry and a specific gas pressure. Conventional lasers can only be modulated to a maximum of 15 percent. Details of the Siemens equipment is not available.

Electronic translator speaks!

Texas Instruments (who else?) have produced a hand-held, electronic translator that not only translates and displays foreign words and phrases from English it will also pronounce them correctly at the same time.



The device uses TI's speech synthesis chip (late of the 'Speak-and-Spell'), along with TMS1000 microprocessor and four 128K bit ROMs.

The speech chip has been modified to improve its diction, although, by all reports, it retains a distinct west-coast American accent!

Plug-in modules give a 1000-word vocabulary, all of which can be displayed but only half are available spoken. English and Spanish modules are reportedly available this month, followed by French, German, Japanese and Chinese next year.

Price of the basic unit is $US250 with language modules at $US50 each. Speech synthesis chips are definitely not available according to a TI spokesman, despite high demand. They've enough trouble supplying their own needs!

US TV expert plays raven

Bob Pfannkuch, president of Bell and Howell's video group in Chicago, brought ill tidings to a Journalist's Club Luncheon in Sydney.

He was referring to the 'home video revolution' — one million US homes have video recorders now and he predicts 20 million will have them by 1983.

According to Pfannkuch, this will bring a decade of bootlegging, pornography and piracy. (Shades of Churchill's Royal Navy . . . rum, sodomy and the lash!)

The advertising industry in the US is worried that those 20 million viewers will not have to watch TV advertising. Tch, tch.

Reminds one of a line from a once well-known Australian poem; " . . . we'll all be rooned, said Hanrahan".

Special technology brings solar power satellites closer

A recent paper in the US Institute of Electronics and Electrical Engineers' (IEEE) journal "Spectrum" gave details of special antenna array equipment that would ensure accurate beaming of the microwave power delivered to Earth from a solar power satellite (see cover feature, April ETI).

Termed 'Retrodirective array technology', the equipment creates a phase front on the transmitting antenna on the satellite from a pilot beam situated on the ground-based 'Rectenna' power conversion antenna. This co-ordinates central logic elements in each of the power satellite's 7 220 subrarrays for what is described as " . . . perfect reference control" of the powerful outgoing microwave beam.

This results in exceptional phase uniformity and precise focussing of the microwave energy onto the ground-based Rectenna, according to the paper. This reduces interference possibilities from beam misalignment and sidelobe radiation.

Any loss of the phase control signal would automatically drop the signal power to a very low three microwatts per square cm, says the author.

Australian elected Chairman of INTELSAT

Mr. Randolph Payne, Director (Marketing) of Australia's Overseas Telecommunications Commission (OTC), was elected Chairman of INTELSAT's Board of Governors on June 7th.

He is the first Australian elected to the post.

INTELSAT is the 102-member country organisation that owns and operates the telecommunications satellites used by countries around the world for international communications, and by a number of countries for domestic communications.

Demand for worldwide international telecommunications, via the INTELSAT satellite system, increased by more than 25 percent during 1978.

INTELSAT's 1979 Annual Report showed that full-time use of their satellites for international service increased by 25% over the Atlantic region, 31% in the Pacific region and 25.1% in the Indian Ocean region — an average of 25.1% worldwide, totalling more than 12 600 telephone circuits.

These statistics do not include occasional-use services, such as international satellite television, which jumped by 53.3 percent to over 11 600 channel hours.

The television demand was boosted by the 1978 World Cup Soccer Championship which became the world's biggest satellite TV event, registering a total of more than 3200 transmission and reception hours and an estimated viewing audience of about one-billion people.

The Report also listed an encouraging charge reduction, for the ninth year in a row, down by 15.8%.

We have it on good authority that Roy Gandy has criminal connections

Roy Gandy is the designer and builder of the phenomenally successful Rega Planar Turntable.

A graduate in mechanical engineering, Roy perfected his turntable design barely two years ago.

It took the British Hi-Fi market by storm. Very quickly there was a waiting list. A long one.

Derek Pugh of Concept Audio returned from the U.K. a little over a year ago with good news. He had secured distribution rights for the Rega Turntable for Australia.

The bad news however was availability — or rather the lack of it. And so for the past year the Rega has been scarce, very scarce.

Not happy with this Derek did some research into Roy's ancestry. Sure enough, Roy's forefathers could well have helped make Australia the place it is today!

Pressure was brought to bear. Not wanting his true heritage revealed, Roy agreed to step up his supplies to Australia.

As a result, obtaining a Rega in Australia is now a great deal easier than it is in the U.K.

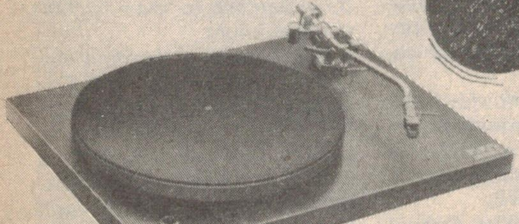
WHY IS THE REGA SO GOOD?

The answer is simple. It "sounds" good. One turntable can indeed sound different from another — a phenomenen only recently accepted in audio circles.

Roy Gandy's mechanical engineering background has helped enormously in his turntable's superior sound qualities. Roy explained "I've paid a lot of attention to the control of mechanical vibration and feedback. The result is a clean, uncoloured sound."

Electronic engineers employed in the design of most turntables just do not possess Roy's mechanical skills. It's very nice to have the "servo-controlled phase lock loop, direct drive overhead cam shaft, blinking light model" but do these features really assist the turntable's sonic qualities?

That's for you to decide. In the meantime, what do the experts say? Chris Rogers writing in "Practical Hi-Fi and Audio" (Feb. 1978) says: "This product achieves a high standard of both design and performance and, as such, can be highly recommended" "Australian Hi Fi" (July 1978) says: "It's 'sound' is very good; among the best we have heard." "Hi Fi Review" (June 1978) says: "We feel this turntable would appeal to anyone setting up a good system on a limited budget and who wants the best sound that monetary constraints will allow."



REGA PLANAR 3
TURNTABLE
(Without arm) R.R.P. $398
REGA PLANAR 3
TURNTABLE
(With arm) R.R.P. $498

rega

Dear Derek Pugh:

Yes, I want to hear a Rega Planar 3 for myself. Please send me reprints of reviews together with the name of my nearest Rega dealer.

Name . . . .

Address . . . .

. . . . Post Code . . . .

Concept Audio

Where only the very best is good enough

Concept Audio Pty. Ltd.
22 Wattle Road, Brookvale, NSW. 2100
Telephone: (02) 938-3700

York Street enthusiasts' market

York Street, right in the heart of Sydney, between the Town Hall and St Martins Tower, seems to be turning into the 'right' address for electronics enthusiasts stores.

Both Dick Smith and Tandy have stores in this block and they'll be joined on the 3rd of this month by David Reid Electronics.

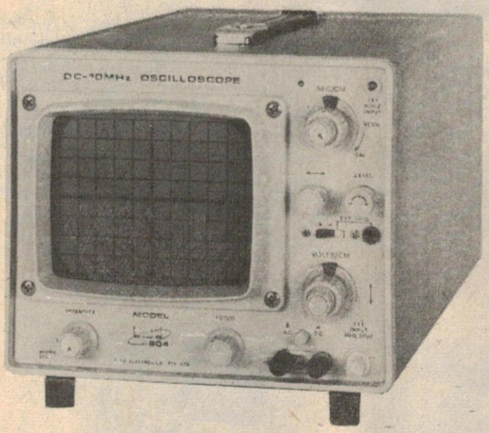
David Reid's new store will be located at 127 York St, right between Tandy and Dick Smith!

I wonder how long it will take one of them to have a spruiker standing outside on Saturday mornings calling out the latest bargains? "Big red capacitors, fresh from Liverpool; juicy tantalums direct from Korea; only ten cents — this morning's special"!

This end of York St is conveniently located opposite a large bus terminus and a few steps from Town Hall station, between Druitt and Market streets.

Economical new BWD scope

The BWD 804 just released by the Melbourne instrument manufacturer is an economically-priced unit with a 10 MHz bandwidth, an 8 x 10 cm screen and 10 mV/cm vertical sensitivity.



One useful feature mentioned in the literature is the isolated ground which allows the measurement of voltages referenced to a floating point.

A Z-input is provided, having a 22 k input impedance, allowing it to be directly driven from either TTL or CMOS circuitry for easy connection to logic analysers.

Overall, the unit seems well suited to the requirements of servicemen, industrial designers and education establishments. Keen enthusiasts may also consider one.

Further information can be obtained from: BWD Electronics Ltd., PO Box 325, Springvale, Victoria 3171. Ph (03) 561-2888.

Clamp power meters

Most readers will be familiar with clamp ammeters — devices which place a magnetic loop around the line to be monitored, a pickup coil measuring the field produced from current flowing in the line.

An extention of this is a clamp power meter — such as the Hioki models recently released here by H. Rowe and Co.

There are four models, each having digital readout, two — the 3133 and 3134, being designed for three-phase systems.

Further information on the Hioki range can be obtained from: H. Rowe & Co., 54 Racecourse Rd, North Melbourne Vic (03) 329-6511.

Hatched, matched, despatched

Brief news on company activities, new outlets, mergers and closures. For those who didn't manage to figure it out last month, the title is a parody on the 'Births, Deaths, and Marriages' columns in the daily papers!

Hatched

Philips Test and Measuring Instruments is to start manufacture of its range of oscilloscopes in the United States. Facilities will be located in Mahwah, New Jersey and first deliveries will be in the last quarter of 1979. According to Philips, growing demand for their oscilloscopes in the US makes local manufacture essential.

Matched

Audio Telex Communications are now distributors of the Switchcraft range of components. Switchcraft make audio connectors, switches, jack panels and specialised telecommunications components.

Audio telex have branches in Sydney (633-4344), Melbourne (277-5311) and Brisbane (44-6328).

The Wholesale Division of GEC have been appointed distributors for Austral Standard Cables who produce a wide range of multicore, instrumentation, audio, television, microphone and RF cables.

Vicom International have been appointed distributors of the well-known Leader test equipment. The agency was previously held by Warburton Franki.

Instant Component Service have acquired a range of products previously distributed by IRH Components (a Division of Natronics Pty Ltd). The range includes components from Schadow, Shinko, Mulon, OMP, NKK, Siliconix, TRW Semiconductors and Hamlin.

Despatched

Ron West, BWD Marketing Manager, has been despatched to America. No, his job is not in Jeopardy (Arizona), he's going to sell the recently released BWD 880 Powerscope! BWD have distributors in seven US states.

Enthusiasts keen on the Sabtronics range of test equipment will be pleased to note that Christie Rand here in Australia can now supply the popular Sabtronics instruments.

Just released is the 8100-600 digital counter with eight digit readout and range from 20 Hz to 600 MHz. Price is $390 plus $58.50 sales tax. The 100 MHz version, the 8100-100, is only $290 plus $43.50 tax. They also have the 2010A digital multimeter, a vast improvement on the old 2000 model, for $180 plus $27 sales tax.

Christie Rand can be contacted at P.O. Box 48, Epping, NSW 2121.

Safety of electronic equipment

In the February issue of Electronics Today (p. 5) a statement appeared in which the New South Wales Minister for Energy, Mr Pat Hills, appealed to the popular electronics enthusiast section of the electrical industry to increase their awareness and observance of electrical safety standards.

Mr Hills expressed the concern of his Government to ensure that the public is protected against risks associated with the use of electrical equipment and that all such equipment meets accepted safety standards.

He indicated that there seems to be a marked lack of appreciation of these standards and of the relevant legislation throughout Australia.

The following statement has been received from the Regulatory Authorities Approvals Committee which consists of representatives of the regulatory authorities dealing with electrical safety matters in all States and Territories of the Commonwealth:

It is believed that no manufacturer, importer or retailer would wish to handle faulty electrical equipment, knowing that it may be the cause of death or injury to unsuspecting users. However, it is not always easy to know just where the safety line should be drawn. Accordingly, safety standards for electrical equipment are developed by the Standards Association of Australia; in the form of Approval and Test Specifications. These are prepared democratically by committees which take into account all the relevant factors including the views of all interests and sections of the industry. Through Australian participation in the international field, these specifications are becoming increasingly aligned with accepted international safety standards.

Under legislation which is uniform in all States, electrical articles may be "prescribed" and, if so prescribed, may not lawfully be sold, hired or displayed unless they have been approved by one of the State regulatory authorities. Compliance with the relevant S.A.A. Approval and Test Specifications is accepted by all States as the basis for approval.

Articles which are not prescribed are not required to be approved prior to sale but they are required in all States to comply with the safety standards when connected to public electricity supply mains. In some States, legislation provides that the regulatory authority may order the withdrawal from sale or use of electrical equipment, whether prescribed or non-prescribed, which possesses hazardous or potentially hazardous features.

Most electrical appliances in general household use and some with a wider application have been prescribed in all States. Most of these prescribed articles are complete appliances, such as toasters, vacuum cleaners, washing machines, etc. However, some prescribed articles comprise components or accessories which may be used in conjunction with or built into equipment which is not, in itself, prescribed. Some examples of these are given below — with relevant comments:

Flexible Cords Specification AS 3191-1974
Locally manufactured flexible cords, with or without moulded-in plugs, may in general be assumed to have been approved. In the case of cords and plugs manufactured overseas, advice should be sought from the regulatory authority.

If the equipment has exposed metal parts which require earthing, the supply flexible cord must incorporate an earthing conductor coloured green or green/yellow. For double insulated equipment, a two-core supply flexible cord must be used.

Plugs and Plug Sockets Specification AS C112-1974
The plug and socket which has virtually become standard in Australia is the three-pin flat pin type, complying with AS C112. For some double insulated appliances, a two-pin plug which will enter the standard three-pin socket is admissible. However, most two-pin mains plugs of the American or Japanese types, having two parallel pins, do not meet the specification and are regarded as unsafe, even if the pins have been bent to engage with the standard socket.

Cord Extension Sockets Specification AS C120-1964
These are plug sockets designed for attachment to flexible cords. Two pin cord extension sockets intended for use in conjunction with the American or Japanese types of two pin plugs would not, generally, meet the specification.

Plug Socket Adaptors Specification AS C122-1964
An accessory whereby a plug of one form may be connected to a plug socket of another (e.g.: two pin flat pin to two pin round pin, etc.) is a plug socket adaptor and must comply with the specification.

Appliance Plugs Specification AS C109-1964
A plug used for connecting the supply flexible cord to a socket mounted on the appliance or chassis is an appliance plug, which is prescribed and must meet the specification.

Cord Line Switches Specification AS 3127-1978
These are commonly connected in the supply flexible cord to the equipment. They must be double pole switches unless used only for the control of an electric blanket or heating pad.

Extra-Low Voltage Transformers Specification AS C126-1956
These comprise transformers supplied as "low voltage" having an output of 32 volts or less. Because of the dependence placed on the safety of extra-low voltage, the specification contains stringent requirements regarding the insulation and segregation between the primary and secondary windings so that, even under fault conditions, primary voltage cannot be impressed on the secondary.

Those extra-low voltage transformers which are prescribed, apart from self-contained transformer units, encompass a wide range of equipment including battery chargers, bench power supply units and power supply units (ac adaptors) for use with cassette recorders, radios, pocket calculators, toys, CB radios, antenna boosters, antenna rotators and similar equipment.

In recent years, regulatory authorities in various States have found a number of shortcomings, of ranging degree of gravity, in the safety features of popular electronic equipment on sale or in the hands of the public. These have included:

The use of prescribed accessories or components as listed above which do not comply with the specifications and have not been approved.

Flexible cords of unsuitable types in use.

Equipment not provided with suitable cord anchorage — resulting in damage to flexible cord and/or reduction of stress on terminals.

Exposed metal parts of equipment not earthed or not effectively earthed.

Live low voltage (above 32V) parts exposed to inadvertent contact or inadequately guarded.

Extra-low voltage (below 32V) wiring or parts not effectively insulated, spaced or segregated from parts energised at higher voltages.

Double wound transformers — and particularly extra-low voltage transformers having inadequate insulation and/or segregation between windings and parts at different voltages.

Electronic circuits and equipment such that a fault occurring in an electronic component could result in a dangerous voltage being impressed on accessible metal parts or attachments (such as microphones, etc.).

The regulatory authority in each State operates an advisory service dealing with approvals and the safety of electrical equipment. Should any doubt arise in these matters, your authority would be glad to assist and advise you. These authorities are:

The State Electricity Commission of Victoria, Monash House, 15 William Street, Melbourne 3000, phone 615-0433.

The State Electricity Commission of Queensland, Cnr. Gregory Terrace and Warry Streets, Brisbane 4000, phone 52-2701.

The Electricity Trust of South Australia, 26-56 Burbridge Road, Mile End 5031, phone 223-0383.

The State Energy Commission of Western Australia, Regulatory Services Section, Cnr. Hay Street and Victoria Avenue, Perth 6000, phone 326-4164.

The Hydro-Electric Commission, Tasmania, 4-16 Elizabeth Street, Hobart 7000, phone 30-1101.

The Australian Capital Territory Electricity Authority, 221-223 London Circuit, Canberra City 2601, phone 48-3111.

The Northern Territory Electricity Commission, Jape Arcade, Cavanagh Street, Darwin 5790, phone 81-8044.

The Energy Authority of New South Wales, Pearl House, 1 Castlereagh Street, Sydney 2000, phone 239-6007, or calls, by appointment, to Approval Section, 2nd Floor, 50 Miller Street, North Sydney.

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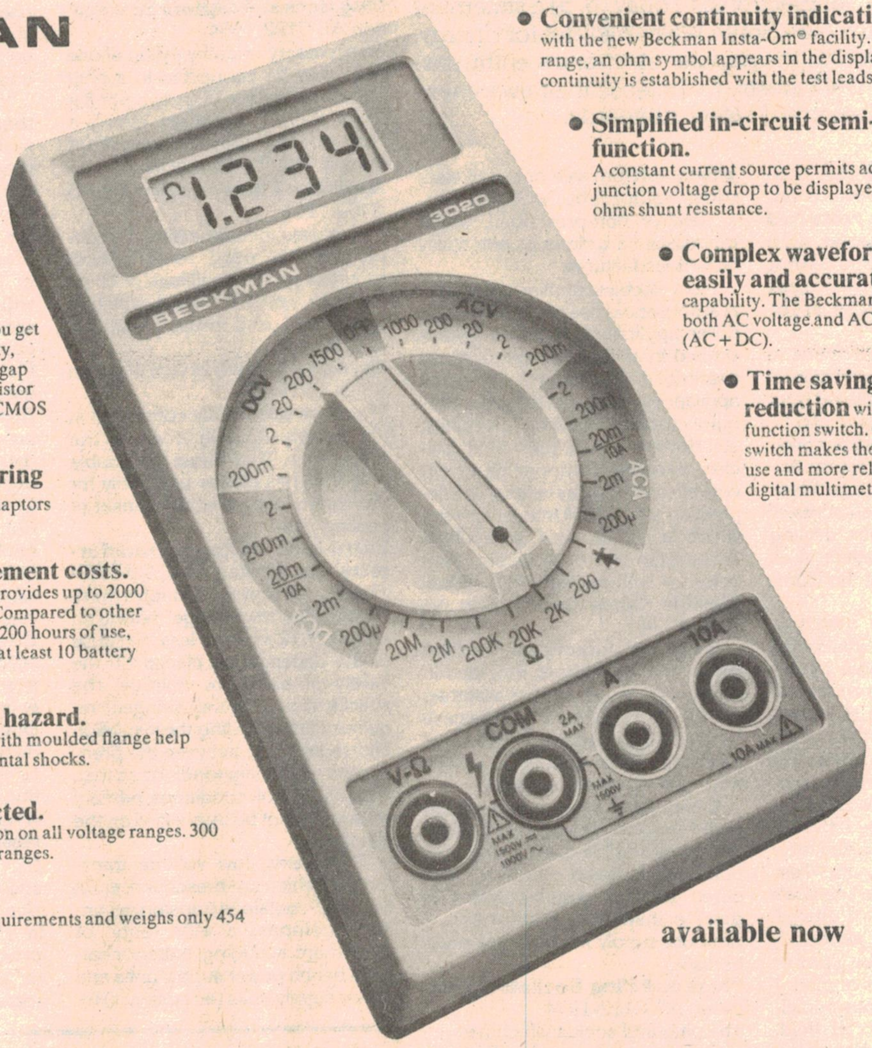

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NAVSTAR — super-accurate navigation using a system of satellites

Brian Dance

"Our job is to put five bombs in one hole", says the US Air Force agency in charge of this project. The Navstar Global Positioning System will be one of the most vital military developments in the next decade. Whilst serving for the accurate delivery of missiles it will also be of use to both military and civilian ships and aircraft.

THE NAVSTAR satellites have been designed to transmit signals which will provide any suitably equipped receiver/computer installation with information for the accurate computation of the position and velocity of that receiver — anywhere in the world. The system has been primarily designed for military use; it will be able to provide user installations (including aircraft) with position and velocity information they require for highly accurate bombing of unseen targets. Indeed, a sign above the Navstar Global Positioning Satellite System's programme office at the US Air Force Space and Missile Systems Organisation in El Segundo, California reads: "Our job is to put five bombs in one hole".

The Navstar system is expected to become fully operational by about 1985 when it will consist of 24 satellites each orbiting the earth twice per day at an altitude of 20180 km. The satellites will be positioned in three orbital planes with eight satellites in each plane. Each satellite will carry three clocks accurate to within one second in 3600 years (1 part in 10^{12}). The position and time signal from each satellite will be daily updated from a ground control station to be located at Fortuna Air Force Station, North Dakota.

Operational stages

The first of the Navstar satellites was launched on 22nd February 1978 by Atlas F boosters from the Vandenberg Air Force Base in California. This became operational on 29th March 1978. It was followed by further launches on 13th May and on 6th October that year.

The first phase of the operation will involve six Navstar satellites in two planes which will provide three-dimensional navigational coverage (latitude, longitude and altitude) over the continental United States. Several more satellites will be launched during the second phase of the project which will include satellites in three planes transmitting two-dimensional navigational information on a world-wide basis. In the fully operational third phase, a three plane, 24 satellite system will transmit three-dimensional navigational information to users anywhere in the world.

The cost of the 24 satellites, 25000 receiver/computer installations and the control station has been estimated at 2420 million US dollars at current values plus 750 million dollars for research and development costs.

The Navstar satellites are being constructed by Rockwell International's Space Division in California for the US Department of Defense.

Accuracy

When a user wishes to obtain the Navstar information, he operates his radio receiver/computer equipment so that it picks up the signals from the four best positioned Navstar satellites for translating the time and range signals. The receiver will lock onto these satellite signals whilst the associated computer will calculate the receiving installation's position, velocity and time. The system is unaffected by weather.

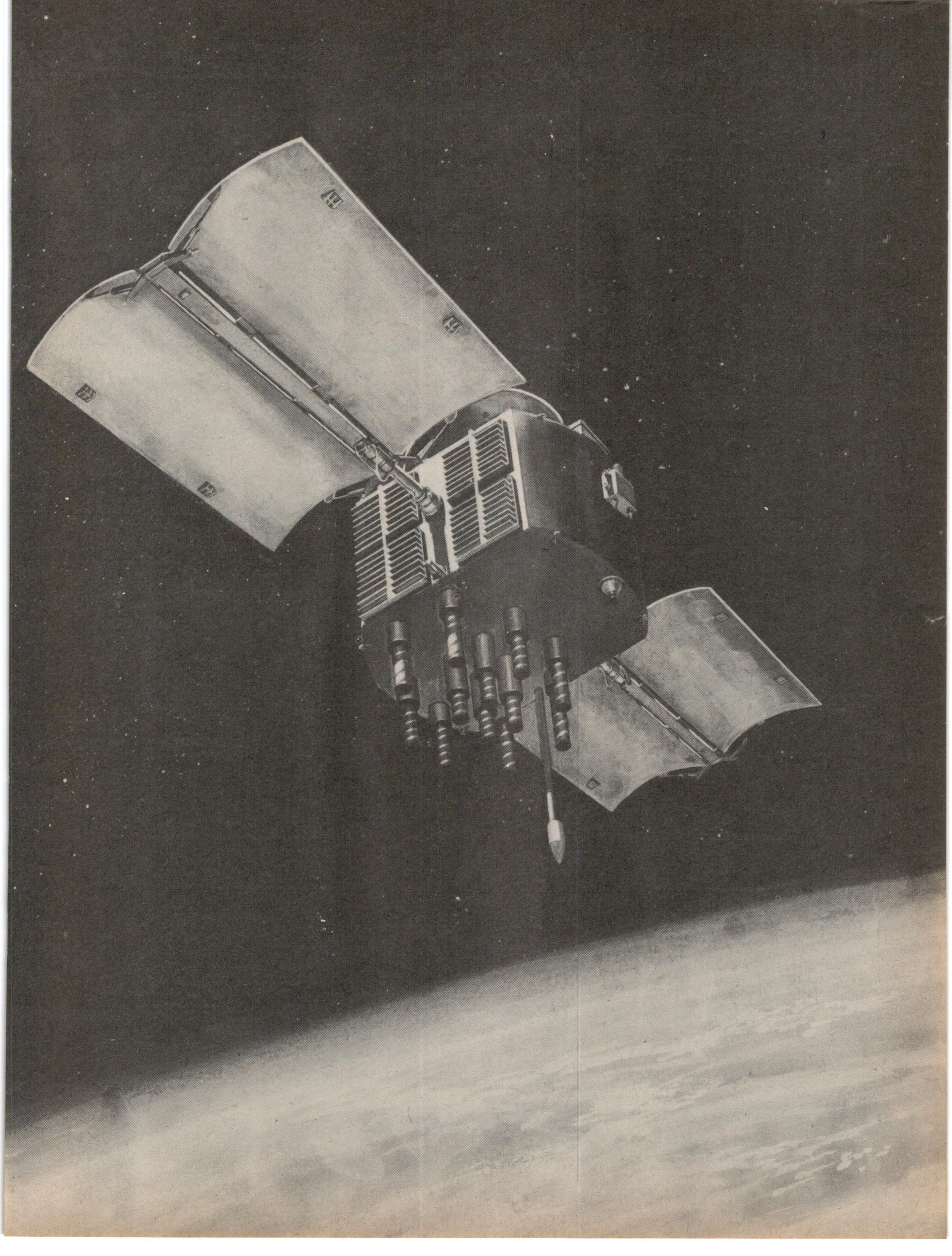
The original requirement was that the computed position co-ordinates should be accurate to within 10 m and the velocity to within 1 km/hour. Actual tests of accuracy, including bombing accuracy, carried out at the US Army Yuma Proving Ground in Arizona are classified information, but it is understood that these first phase tests have exceeded all expectations. Positions accurate to 50 nanosecond have been quoted.

Although the Navstar system has been primarily designed for use by land, sea, air and space vehicles, a man-pack receiver carried by one person has been under test since October 1978 with very satisfactory results.

The satellites

Each Navstar satellite has more than 33000 parts in eight major subsystems. Multiple redundancy is used in critical parts, such as the three atomic clocks, so that a design life of five years is possible. The weight of each satellite on separation from the booster is about 750 kg and about 450 kg on insertion into its final orbit. Although the first few Navstar satellites have been launched by rockets, it is planned to use

Artist's impression of a NAVSTAR Global Positioning System (GPS) satellite in orbit. The L-band shaped-beam helix array transmission antenna is visible on the underside of the craft. ▶



the Space Shuttle to carry one or more Navstar satellites into low earth orbit on a single mission when the Shuttle facilities become available.

The solar panels are deployed in orbit to give the satellite a length of 5.33 m between the tips of the two solar panel arms. The 5.01 m^2 area of solar cells provides an output of not less than 410 W at the end of life stage, whilst each satellite also contains three nickel-cadmium batteries, each with a capacity of 15 A-hour.

The satellites carry many antennae to transmit their navigational information, to receive command signals and to transmit telemetry and tracking signals. Omnidirectional antennae operating in the S band (around 2300 MHz) are used for telemetry, tracking and command, with common antennae for transmission and reception. They include an aft spiral and a forward conical spiral with a biconical horn.

For the transmission of the L band navigational signals, a shaped-beam helix array antenna system is employed at the

Phase 1 Orbit Traces

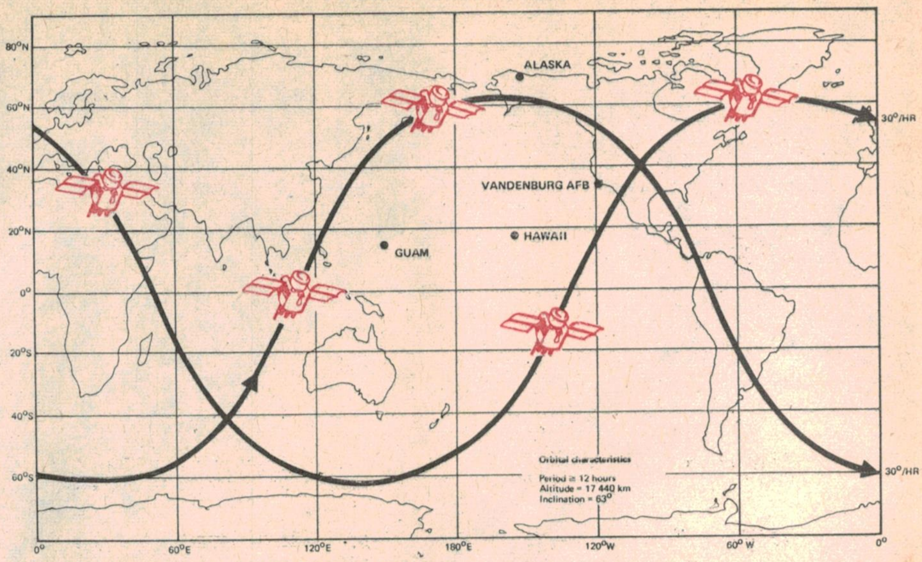
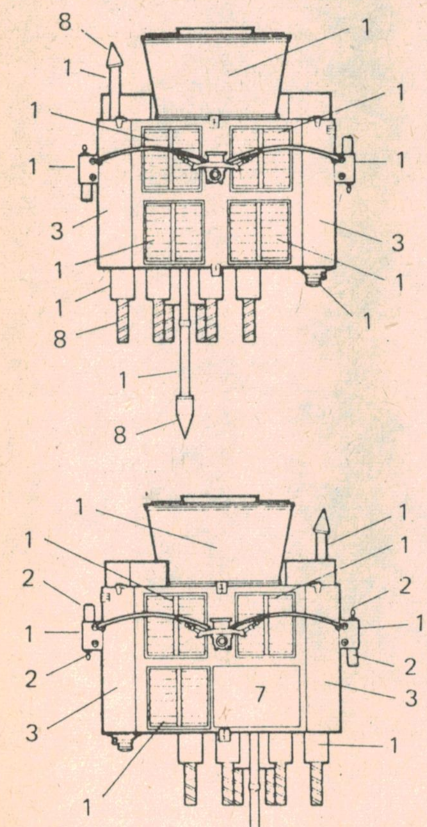
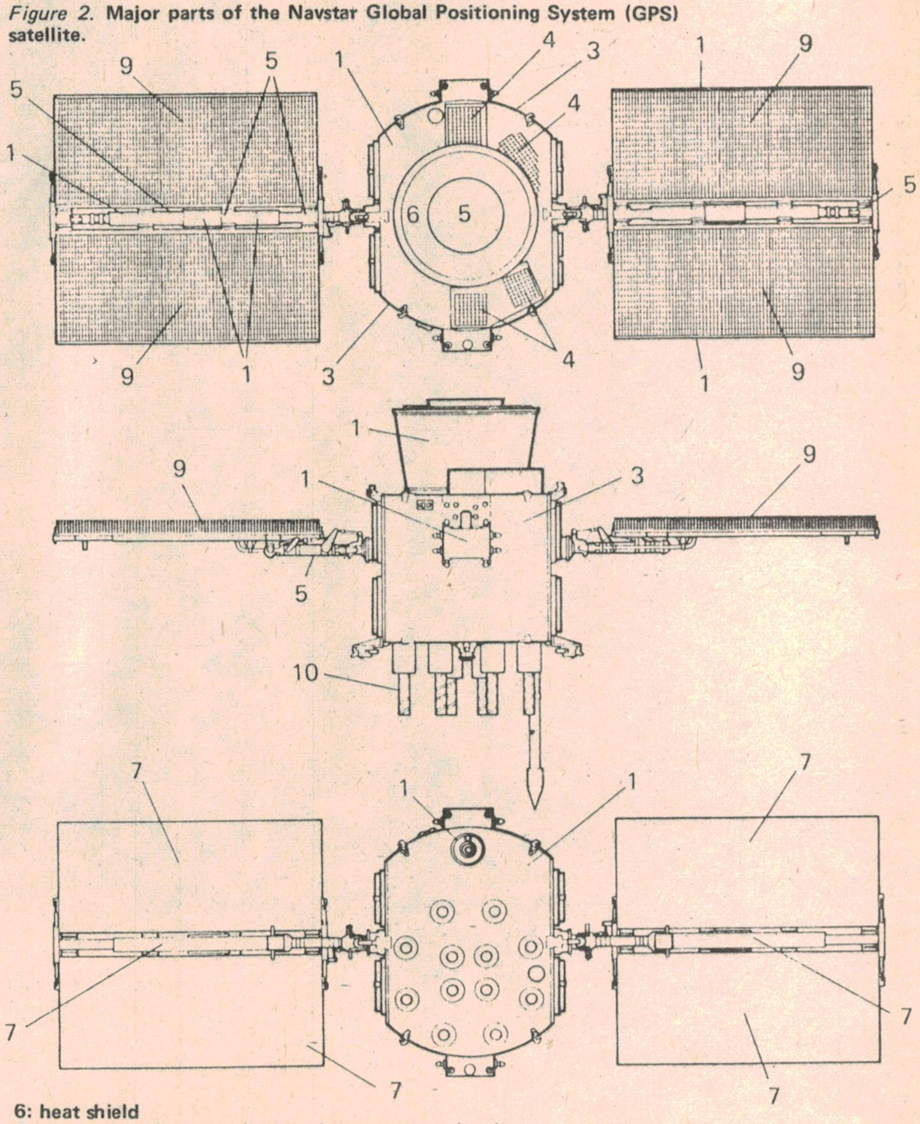


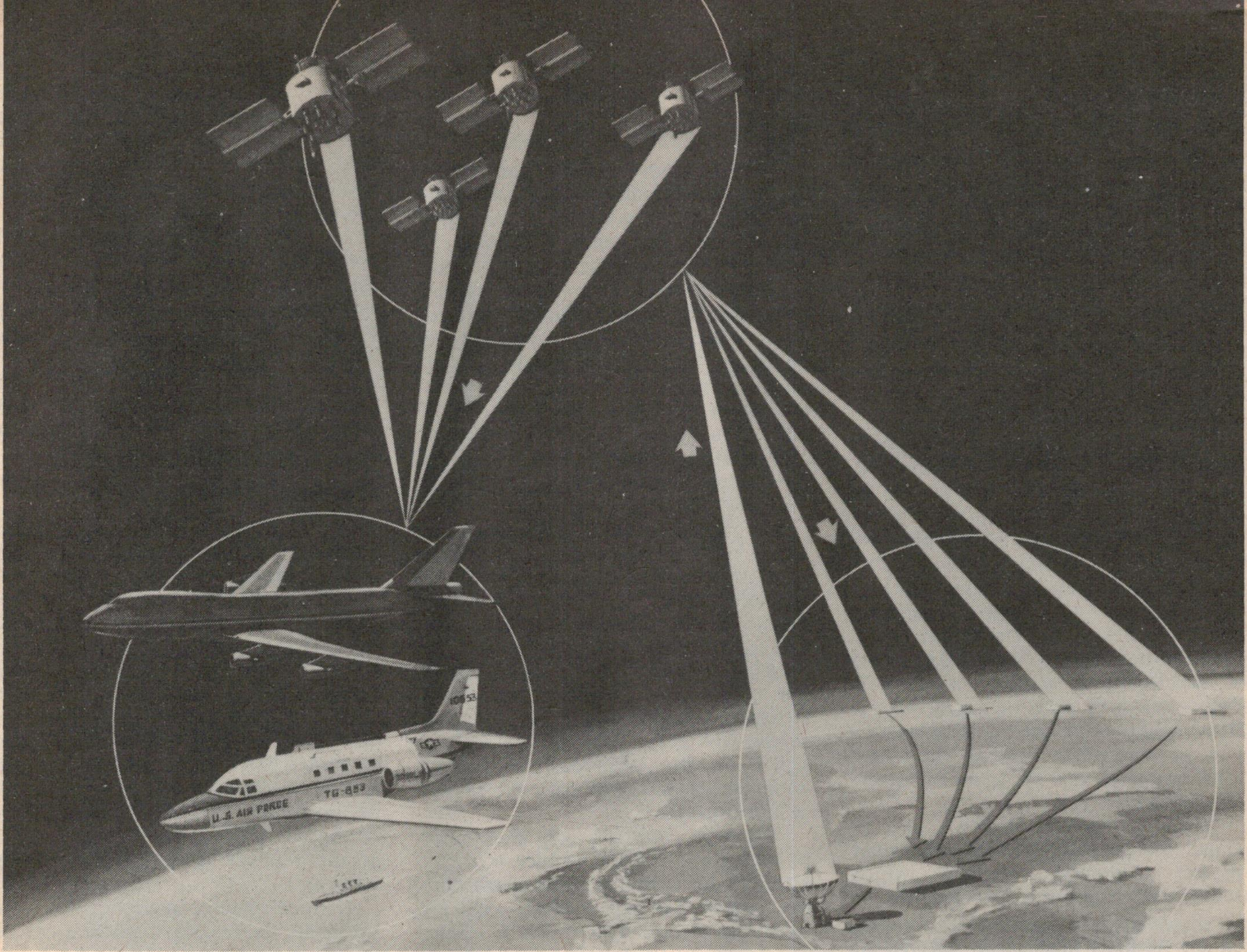
Figure 1. **Orbit traces of early Navstar craft.**

Figure 2. **Major parts of the Navstar Global Positioning System (GPS) satellite.**





1: general base assembly gear
2: reaction control subsystem nozzles
3: access panels
4: battery covers, single surface mirrors
5: solar array arms, (top) motor nozzle
6: heat shield
7: reverse of solar array (bottom), power amp. (top)
8: navigation antennas, S-band antenna
9: solar cells
10: helix array navigation antennas



A master control station transmits command and time correction signals to the Navstar satellites. The satellites send signals to four monitor stations in Alaska, Vandenberg Air Force Base, Guam and Hawaii which pass the monitored signals to the master station. Four satellites pass signals to user craft.

front of the satellite. This can transmit a pseudo-random noise signal, a normal mode L_1 clear/acquisition signal at a level of +26.8 dBW and in a high power mode at +28.8 dBW together with other signals.

The reaction control system for moving a satellite uses an array of jets. These employ the normal hydrazine propellant which is catalytically broken down into nitrogen and hydrogen gases in a reaction chamber. These gases are then fed to the jets which provide the force to move the satellite. Two thruster jets develop a thrust of 22 Newton each, whilst another sixteen thrusters each provide a force of 0.44 Newton.

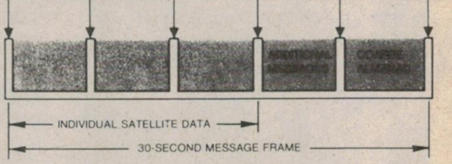
Each satellite is constructed from aluminium honeycomb panels and spin on their major axis. The solar cell panels rotate through 360° so that they always receive sunlight directly on their surface.

Receivers

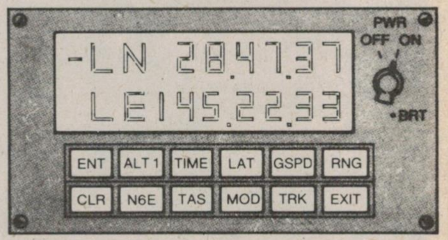
The Navstar system will enable simultaneous use by an unlimited number of users with the advantage that the location of a user will not be revealed by the use of the system. The US Space and Missile Systems Organisation hopes it will be possible to employ only a limited number of receiver types for use with the Navstar system – perhaps one or two basic receivers for most purposes, a very economical receiver for small civilian aircraft and a special military receiver system for space vehicles.

Problems arise in the design of small, hand-held receivers to weigh about 5 kg to 7 kg, whilst very different problems arise in the design of very high performance receivers for fast fighter aircraft incorporating the required anti-jamming systems. The most difficult problems arise with the development of radio frequency systems and interfacing with the data processors.

Simple omni-directional antennae may be satisfactory for some users, but for installation on military aircraft and ships likely to be subjected to intense jamming, highly directional antennae will be required. For example, Raytheon has provided a 36 element lens antenna to Collins Radio for testing. This Rotoman lens antenna is about 400 mm by 400 mm in surface area, 9.4 m^3 in volume and weighs about 5.44 kg. It can place a null on the direction from which jamming signals are coming and can direct its beam at four selected Navstar satellites.



The 30 second coded message transmission format from Navstar.



Typical display from Navstar reception equipment. A broad range of navigation, position and related data may be displayed.

An antenna which places a null on a jamming signal can reduce the effect of the jamming signal by at least 15 dB. If it uses signal strength alone to null out the jamming signal, the antenna operates independently and does not require the separate computer used in beam forming techniques. In addition to the use of a suitable antenna for reducing the sensitivity to jamming signals, the use of adaptive notch filtering and a pseudo-random noise coding system in the satellite transmissions will ensure that most high performance receiver systems will be able to use the Navstar signals.

Fast moving receivers, such as those in missiles and aircraft, will require their navigational information as rapidly as possible. So will submarines which must surface for the minimum possible time to receive the Navstar signals without unduly compromising their location. Such systems will employ receivers which simultaneously track four separate satellites, whilst Texas Instruments is developing a receiver which will detect and lock onto the signal from a fifth satellite — before releasing lock on one of the other four as the latter satellite moves out of its most favourable position.

Slower moving vehicles, such as ships, will usually employ somewhat more economical receivers which sequentially track the four satellites so that the signal from only one satellite is received at any one time.

The transmitted signals

All signals from a satellite are timed by a very stable master oscillator operating at a nominal 10.23 MHz (actually the frequency is reduced to 10.22999999545 MHz so as to provide some correction for both special relativistic and general relativistic effects) The master oscillator frequency is multiplied by factors of 154 and 120 to generate two frequencies for transmission in the L-band, namely 1575.42 MHz (known as the L_1 signal) and 1227.6 MHz (known as the L_2 signal). Both are transmitted as circularly polarised signals from each satellite.

The L_1 signal is modulated with a 1023 bit clear/acquisition C/A signal of 1 ms code duration and also by a seven-day long high precision P-code signal in phase quadrature with the C/A signal. The L_2 signal is normally modulated with the P-code signal, but a command from the ground can switch the modulation of the L_2 signal to the C/A code. Both the L_1 and L_2 signals are also continuously modulated with the navigational data bit stream at 50 bits/second.

The C/A code is a very short code operating at 1.023 Mb/s which is readily acquired by a receiver, but which does not provide the high accuracy available from the P-code. The P-code is a long precision code operating at 10.23 Mb/s which is very difficult to acquire other than by transfer from the C/A code. The pattern in the P-code repeats itself only once every seven days, starting at midnight each Saturday ("Everybody loves Saturday night . . ." — Ed.).

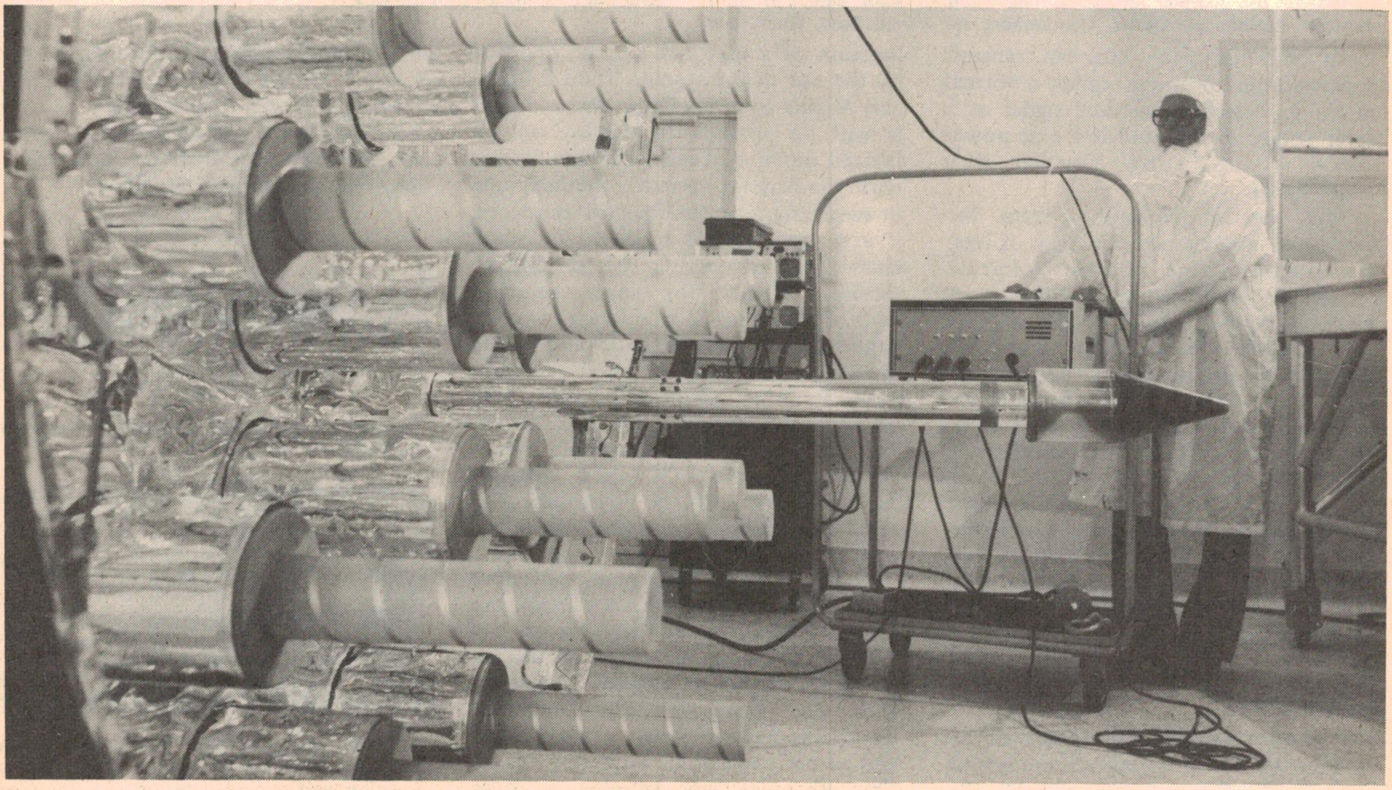
It is possible for receivers with precision clocks accurately synchronised with GPS time and an approximate knowledge of their position (to within about 3 km) to acquire the P-code directly. Direct acquisition of the P-code is not possible unless the receiver knows approximately which time section in the seven day code to search.

Computation

When a user switches on his GPS receiver system, it operates automatically and continuously, locking onto four favourably located satellites and synchronising its own crystal clock with the GPS master system time. All satellites begin to transmit their coded messages at the same instant of time, so the receiver system notes the exact time each signal is received and computes the time difference between its transmission from the satellite and its reception. This time, multiplied by the speed of light, equals the distance of the receiver from the transmitting satellite.

If three or more such measurements are made, the receiver's position can be

A NAVSTAR GPS satellite being assembled at the Rockwell International Laboratories.



computed by simple triangulation. The signals from only three satellites would be adequate if each receiver system incorporated its own highly accurate clock synchronised to GPS time; in order to avoid this requirement, signals from four satellites are used to compute the required information.

The best military equipment will use the dual frequency operation with the P-code. The US Government has agreed to make the C/A code available to commercial users, but no decision has yet been taken as to whether the more accurate P-code data will be available to non-military users. A receiver using the C/A code in a simple system, with a single channel receiving only the L_1 frequency, could compute his position to within about 300 m. This is accurate enough for many purposes enabling low cost receiving equipment. It could well replace the TACAN navigational system with the advantage that it would provide world-wide cover instead of the 25% of the world presently covered by the TACAN system.

Errors

The errors in a high performance dual frequency P-code system may be summarised as follows. The space vehicle clock errors and positional information lead to an error of the order of 1.5 m in the computed position, atmospheric propagation delays about 2.5 m to rather over 5 m, a 1 m error may arise from the passage of the signals through the satellite equipment, multipath reflections may give rise to errors of 1 to 3 m, whilst receiver noise and vehicle movement at the receiver may contribute an error of about 1.5 m. If these errors are added quadratically, the overall error works out as about 3.5 to 5.5 m which is typical of the results obtained in practice.

When a simple receiver is used to receive only the C/A signal, one has not only the additional errors involved in the use of this signal instead of the P-code, but also errors due to the absence of any correction for ionospheric and atmospheric effects.

Time is obviously the main factor which determines the accuracy of the computed results. It is expected that a hydrogen maser clock will be flown in a satellite in late 1981 and will provide a stability of about one part in 10^{14} per day. Although the current plans are to correct the satellite clocks once per day from a master control centre, it seems likely that the hydrogen maser clock will be accurate enough to operate without any ground support for a time (such as during a short war), since such a clock would have an accuracy of about one second in three million years.

TRANSIT comparison

It is interesting to compare the performance of the GPS system using the accurate dual-frequency P-code with that of the TRANSIT navigational system used by the US Navy. The TRANSIT system employs five satellites circling the earth at an altitude of 1111 km which can provide users with accurate positional information on a world-wide basis.

However, the GPS signals are available for use at any time whilst the TRANSIT system will provide a single position fix each time one of the TRANSIT satellites is in view of the user. The average interval between successive fixes is about 1½ hours, but at times much longer intervals of several hours occur between the times at which positional information can be obtained. These longer times are especially likely to occur at low latitudes.

The accuracy of the positional information provided by TRANSIT satellites is comparable with that of the GPS system when the user is stationary, but is severely affected by the velocity of a ship which is not accurately known. In practice this results in errors of the order of 200 m in each positional fix of a merchant ship.

The altitude of the GPS satellites is over 18 times that of the TRANSIT craft.

Civilian uses

When used by commercial airlines, NAVSTAR'S accurate positional information will enable pilots to calculate the velocity of the airliners with respect to the ground and will thus enable the most favourable routes to be computed, allowing for the prevailing wind conditions etc. The navigational information can also be relayed to air traffic control on the ground so that automatic flight control becomes possible.

In the event of an air accident in remote country areas or over the sea, the precise positional information prior to the landing of an aircraft (or the abandoning of a ship) will greatly assist rescue operations to reach the correct point in a minimum of time.

Merchant vessels using the GPS system will be able to obtain their velocity relative to the earth, and hence that of the ocean current, so that they can select the most favourable route between two ports. They will be able to keep accurately to great circle routes and hence to save both time and fuel. Indeed, it has been estimated that large vessels could save between 10 000 and 20 000 dollars at each Atlantic crossing using the GPS navigational system. In addition, NAVSTAR could be used in collision avoidance systems and for preventing oil spillage from large tankers due to navigational problems.

Strangely enough Navstar information is also of use in radio astronomy, where precise timing is essential. The two frequencies transmitted by each Navstar satellite enable measurements to be made on the signal delays, and hence the concentration of free electrons in the ionosphere which affect observations.

Secondary payloads

Suggestions have been made that the GPS satellites could carry secondary payloads which will provide for secure strategic communications and a world-wide surveillance of nuclear explosions. Transponders for these payloads have been developed by Rockwell International at Anaheim, California; it is believed that the placement of such transponders on the proposed 24 Navstar satellites will probably provide a communications system which cannot be destroyed or interfered with except with extreme difficulty.

A single channel transponder for secure communications is planned for inclusion on the Navstar satellites. The downlink frequency will be in the 240 MHz to 270 MHz region with up-links to the satellites in the 318 MHz band. It is expected that the bit error rate will be less than 1 in 10^5 and the minimum transmitter output power 20 W.

Conclusions

Much work remains to be done on the design of economical precision receiver/computer systems for military and domestic applications. Perhaps it is rather remarkable that receivers must track accurately the received GPS signals even though the signals are usually well below the thermal noise level in the receiver. The relatively low radiated power from the distant satellites produces a received signal level of perhaps −165 dBW and a signal-to-noise ratio in the 20 MHz wide front-end of the receiver of around −40 dB. It is only because of the codes used (which provide about 70 dB of processing gain) that the system can operate at all.

Acknowledgement is made to Rockwell International's Space Division for all of the photographs used to illustrate this article and for information they have kindly provided. Thanks also to General Dynamics Electronics Division for very detailed information on the GPS system. ●

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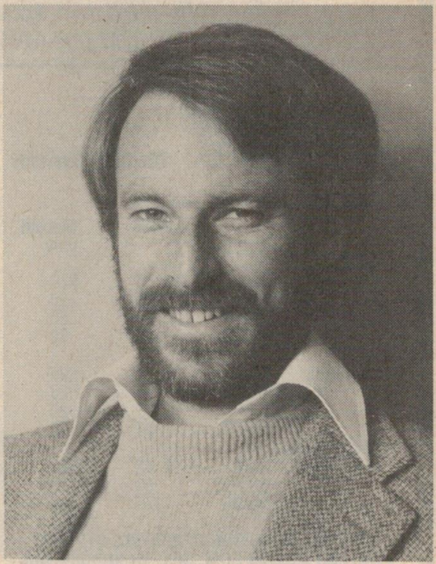
Phil Wait



BORN IN SYDNEY in 1951, Philip progressed from disassembling the kindergarten clock, through the Meccano phase to discovering for what then (circa 1961) passed for electronics.

At about this point his parents thought he should have a proper education. His arrival at Sydney Grammar created little impression (he was only a small lad, you see), but we doubt the government surplus stores in nearby Oxford Street, Darlinghurst, have ever quite recovered!

Thence followed Phil's construction phase . . . we have no idea when it will end. A long line of amplifiers gave way to transmitters of every conceivable shape and form – some of which were even received as far away as . . . the end of the street!

Upon leaving the sandstone bosom of Sydney Grammar, Phil found himself in possession of:– a Higher School Certificate, a driver's licence and an amateur radio licence (much to the relief of the District Radio Inspector!).

A career in electronics seemed natural – and what better place to commence than in the granite bosom of the Government. Chipping his way inside the Overseas Telecommunications Commission, Phil was despatched to Technical College to do the Electronics and Communications course. With the absolute minimum of work, he passed the course in two years.

For this, OTC rewarded him with a trip around Australia. Unfortunately, they also required him to do some work – installing radio transmitters at various coastal stations used for ship-to-shore communications. For being such a good lad and helping out he was sent to the Ceduna (South Australia) satellite earth station.

Finally, Phil discovered that what the Government expected him to do was about as interesting as working in a soap factory, and perhaps not as clean.

Returning to the true history, Phil escaped the Commission's concrete embrace and took some time out to think – meanwhile wandering around New Zealand. Deciding a change was necessary, he next found himself with a scalpel in one hand and a soldering iron in the other. Medical electronics at Sydney University's Physiology Department proved interesting for a time, but the Electrical Engineering Department decided their need was greater. Besides, they offered him more money – a fatal mistake.

Life at the University was not wholly eventful, and, finding some spare time on his hands (not to mention his seat), Phil started writing for ETI.

Now this is where the story really starts! Being in the right place at the right time – when ETI was contemplating setting up the present design lab, Phil was scrutinised as a candidate. Realising that he could design suitable projects and write articles, but knowing he definitely couldn't spell, Collyn Rivers offered him the job of Project Manager. Phil leaped into the paper mache embrace of Modern Magazines.

Somewhere along the line Philip was seduced by the thrill of a fluttering white sheet and the splash of foam in his face . . . . sailing! He's joint owner of a Hobie Cat and recently crewed on a boat that won the '79 Winter Series races on Sydney Harbour. Thus inspired he'll be off in March next year with the Batavier, a locally-made 25 m ketch, to join the Spice Race from Jakarta to Rotterdam. The crew of the Batavier hope to beat the 130 year-old record set by the famous Cutty Sark.

Likes: sailing anything, Guinness, squash, renovating old houses, bush music, motorbikes, DX and of course, Monty Python. Dislikes: power boats, Bailey's Irish Cream, two-stroke motorbikes, tennis, losing boat races, health food freaks and sales reps who promise the earth and give nothing.

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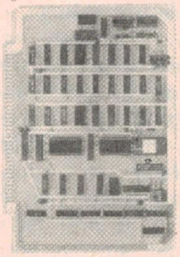

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	KIT	ASSEM.
32K	$569	$599
24K	469	499
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8K	249	275

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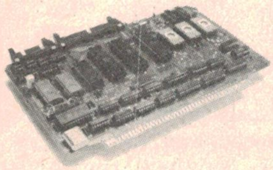

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- 2 ACIA's — RS232
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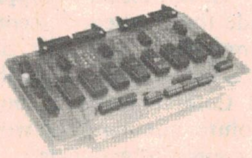

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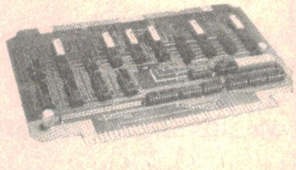

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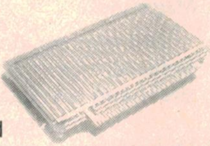

- Double-sided ground & plus 5V
- plus/minus 12V on card
- Plated holes
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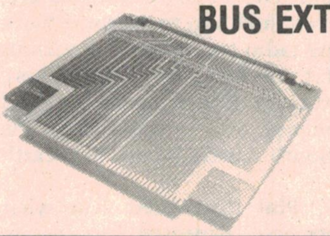
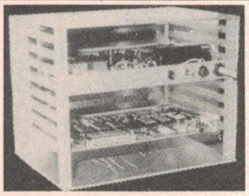
BUS EXTENDER BOARD



$68



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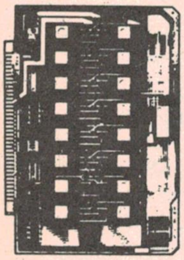

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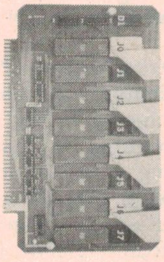

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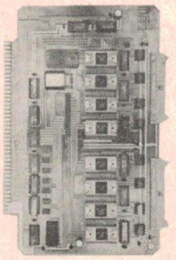

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47uF	9c($5)	10c($6)	11c($7)
100uF	10c($6)	12c($7)	14c($11)
220uF	12c($8)	16c($10)	35c($17)
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.0022 - 5c	.022 — 6c	.22 — 15c
.0027 - 5c	.027 — 6c	.27 — 16c
.0033 - 5c	.033 — 7c	.33 — 18c
.0039 - 5c	.039 — 7c	.39 — 19c
.0047 - 5c	.047 — 7c	.47 — 20c
.0056 - 5c	.056 — 8c	
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Biofeedback — a bridge to bionics

Tom Benjamin

Machines to aid human motor functions, or to replace functions lost through birth defects or accidents, are now able to be linked to the brain using electronic biofeedback techniques — chief among these being the electromyogram, a sensor of the tiny bio-electrical impulses controlling muscle activity.

"Why should we offer you a pilot's job?", asked the interviewer.
"In addition to my considerable private experience, I have superior reflexes", replied Geoff.
"But surely a desk job would be more suited to your . . . uh . . . capabilities."
"My 'handicap', you mean? . . . perhaps an old trick could help me make my point. Would you mind placing your thumb and finger on either side of this card? . . . Now see if you can catch it when I drop it . . . before it slips through . . . Ready?
Without warning, Geoff then dropped the card . . . the interviewer's fingers closed on empty space.
"Now you try it," said Geoff.
The interviewer dropped the card without warning . . . it fell about 10mm before Geoff caught it.
"Following my accident," said Geoff dispassionately, "the surgeons put me back together again . . . the engineers made some improvements . . . this is one of them. There are others . . ."

THE short story above, imaginary though it is, may very well represent a real-life situation in the not too distant future.

Geoff, the bionic pilot, isn't flying yet but our minds have been prepared for his appearance years in advance thanks to 'The Six Million Dollar Man' and 'The Bionic Woman' — souped-up, sexed-up versions of last century's Frankenstein's Monster.

Today's handicapped person may sometimes feel like a "Six Dollar Man" compared with TV's Steve Austin. However, the stigma attached to prosthetic devices such as electric wheelchairs, artifical legs, and hearing aids may someday give way to the sort of intrigue and admiration we feel toward TV's growing bionic community.

From another direction, we have been increasingly prepared for the appearance of more human-like robots (see ETI July/Aug '78). The 'droids' of *Star Wars* are the only characters beside the noble Ben who show a selfless compassion — as when C3PO offers to lend his own components to his comrade R2D2. (They are also the only characters refused entry to the pub!) Today's Sci-Fi robots are much more introspective and soul-searching than ever before.

Thus, the media has looked at the bridge between man and machine from both ends. The engineer who builds a more human 'droid' and the biologist who creates machine-like capabilities for the human are each working towards a new species. A quite believable example from *2001: A Space Odyssey* was the Jupiter space craft complex, with its combination of human crew and HAL, the computer, vying for control of the mission. An alien spacetraveller might well have had difficulty in figuring out "Who's in charge here?" in a close encounter with this craft.

Current progress in bionics

In November 1978, Dr. G. Shannon, of Queensland University, published an account of a "myoelectrically controlled hand" capable of providing sensory feedback about the strength of grip applied by its electric motor — possibly the first of its kind accepted and used for any length of time by its recipient.

The mechanism used for providing a sense of "touch" was a pair of strain gauges attached to the mechanical fingers to register the slight bend which occurs when grasping. The sense of "force" was provided by an electromyograph (EMG) which amplifies the electrical activity of a muscle's nerves, converting this to a signal capable of controlling the motor. The EMG was attached to the forearm between the elbow and the patient's amputated stump. The muscles measured in this case normally control movement of the fingers — now they control an electric motor in an artificial hand.

The brain is regarded as "the last defence perimeter" of a person's identity. Fears of electrical stimulation and control of the brain have been expressed in such works as *Brave New World* and *The Terminal Man.* However, it seems likely that many severely handicapped persons will gladly trade some amount of personal identity and privacy for increased abilities with which to contact and manipulate the outside world.

Today's multiply-handicapped person — quadraplegic or brain-damaged, can look forward to a pretty sedentary life. A number of complex switching circuits can put such amenities as a typewriter, TV, and intercom at the person's disposal. Currently, these circuits interface via a blow-tube on/off switch or, more recently, via a matrix system switched by photocells activated by a beam mounted on the head. Neither of these systems can provide the multichannel, simultaneous, analogue type of control required for complex movement and manipulation. A more direct interface is required.

In addition to artificial hands, there

BIONICS: *The emulation of biological components, 'body parts', with electromechanical ones with the object of their ultimate replacement.*

Illustrating muscle relaxation training using our own electromyogram project (see page 35). This project design is based on criteria given by the author of this article and compares very well with commercially made machines. Learning to relax is Jan Collins, our general secretary and office organizer. . . . note calm expression, unfurrowed brow and general aura of peace!

are a variety of aids being perfected to replace and assist the eyes, ears, and legs of those who are denied their use, either by birth or accident. Implantations in the visual cortex of an electronic grid which produces light sensations have brought artificial vision closer to reality than dream. Similar experiments with the auditory cortex have shown promise, although the frequency range perceived has thus far been limited.

Biofeedback

In 1901 the psychologist, J.H. Blair, sought to shed light upon "the nature of the will" by observing how subjects learned to direct muscles to serve a mental command. He taught his subjects to wiggle their ears by observing their efforts amplified via a system of pressure-filled drums onto a kymograph ▶

MAN VERSUS MACHINE: A COMPARISON

What are some of the strengths and weaknesses that each brings to an interface between man and machine? (see ETI July '78). The space programmes and the nuclear arms race have forced a perhaps premature look at these issues. The age of cloning and bionics may well force a further look. A shopper for bionic and cloned components might keep the following shopping list:

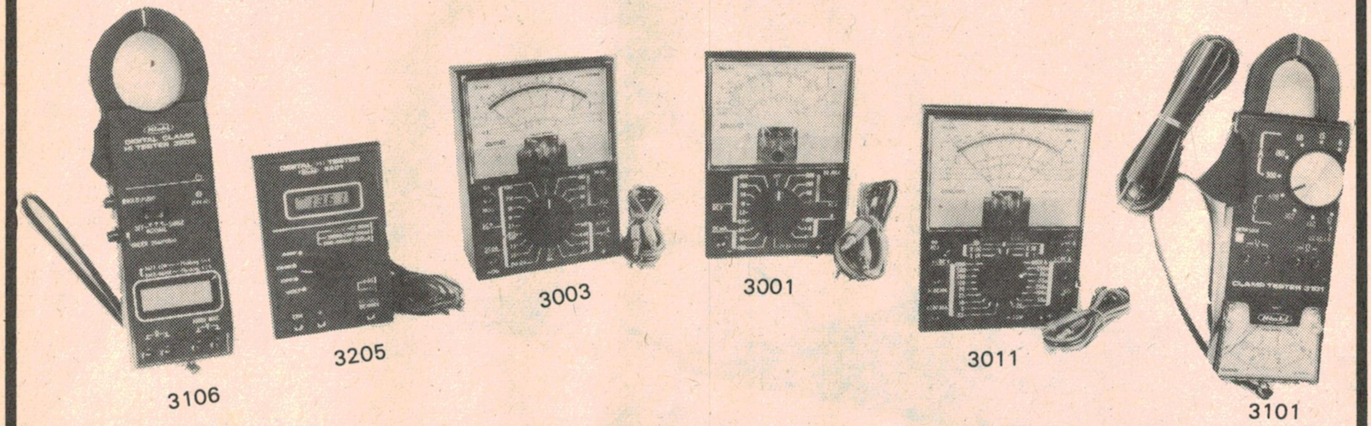
SPECIFICATIONS AND FEATURES

MAN	MACHINE
on-line processing and data reduction of multi-sensory input	reliance upon external sensors
large CPU capacity (10^{20}bits) relative to size	limited CPU dependent upon size
delicate components require an artificial environment	capable of operation in extremely hostile environments
reliability through redundancy; multiple back-up systems	reliability through strength of components
learning capability	very limited learning capability
direct interface difficult due to the body's rejection systems	modular construction allows limitless interface
indirect opto/mechanical interface with outputs	direct amplification of outputs
complex manipulative ability	strong but clumsy manipulative ability
flexibility in short-distance locomotion over rough terrain	capable of fast, extended travel over large distances — land, sea, air, space
low energy consumption: $<$ 100 W	high energy requirements
low energy output: $<$ 400W	high energy output
must be protected	disposable
must be maintained alive	can be switched off indefinitely

Well, shoppers which would you choose . . .
- if you wanted to move a 'fridge up two flights of stairs?
- if you wanted to turn out small components on an assembly line?
- if you were outfitting a craft bound for Alpha Centauri? . . . the Greek Isles?

Hioki

Dependable Multitesters



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0.25/2.5/10/50/250/1000V DC 2k Ω/V ±3%
0.5/10/250mA DC ±3%
10/50/250/1000V AC 2k Ω/V ±3%
3k/30k/300k ±3%F.S. R.C. 26Ω

3002 PRACTICAL COMPACT TESTER
0.5/2.5/10/50/250/1000V DC 20k Ω/V ±3%
50 A/25/250mA ±3%
10/50/250/500/1000V AC 9k /V ±3%
10k/100k/1M ±3%F.S. R.C.100Ω
L.F. Output —20 to +36dB ±4%

3003 PRACTICAL MEDIUM CLASS TESTER
0.25/2.5/10/50/250/1000V DC 30k Ω/V ±3%
5Cµ A/2.5/25/250mA/10A DC ±3%
10/50/250/1000V AC 13.5k Ω/V ±3%
10A AC ±4%
5k/50k/500k/5M ±3%F.S. R.C.50Ω
L.F. Output —20 to +36dB ±4%

3005 HIGH CLASS TESTER WITH RELAY PROTECTION
0.25/1/2.5/10/50/250/1000V DC 50k Ω/V ±3%
50uA/2.5/5/50/500mA/10A DC ±3%
10/50/250/1000V AC 10k Ω/V ±3%
10A AC ±4%
2k/20k/200k/2M ±3%F.S. R.C.20Ω
L.F. Output —20 to +36dB

3010 HIGH SENSITIVITY (10µ A OPERATING CURRENT) TESTER WITH RELAY PROTECTION
0.1/1/2.5/10/50/250/500/1000V DC 1000k Ω/V ±3%
10 A/100µ, A/1/10/100/500mA/10A ±3%
10/50/250/500/1000V AC 10k Ω/V ±3%
10A AC ±4%
2k/200k/2M/20M ±3%F.S. R.C.20Ω
L.F. Output —20 to +36dB

3011 HIGH CLASS WIDE RANGE TESTER FEATURING ELECTRONIC RELAY PROTECTION
2.5/5/10/25/50/100/250/500/1000V DC 40k Ω/V ±2%
25µ /50µ /100µ /250/2.5m/25m/250m/2.5A/10A DC ±2%
2.5/5/10/25/50/100/250/500/1000V AC 10k Ω/V ±3%
25µ /50µ /100µ /250µ /2.5m/25m/250mA/2.5A/10A AC ±3%
3k/30k/300k/3M ±2%F.S. R.C.20Ω
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AC A 0-200µ A/2000µ A/20mA/200mA

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(early chart recorder). A notched lever fitted to the wall of a drum transmitted small ear movements as pressure changes to a second drum to which was affixed a chart-pen. The subjects made efforts to wiggle these long-disused muscles and were rewarded by feedback from the pen tracing.

Today we know this principle as "Biofeedback" (see ETI Sept. '76). By monitoring the various activities of the body with today's sensitive electronic equipment, an average person can learn to control a variety of bodily functions as adeptly as many trained Yogi's. Such activities as heartrate (see ETI – 544, Sept. '76), skin temperature (ETI – 130), skin conductance (ETI – 546), blood pressure and brainwave synchrony can be readily measured and converted into an audio/visual signal suitable for providing feedback to the trainee.

In the early '60s, Dr. John Basmajian investigated the ability of persons to control the 'motor units', which are responsible for muscle contraction, using EMG biofeedback. He used needle electrodes 25 μm in diameter, inserted beneath the skin to contact a large number of the tiny motor units. The oscilloscope tracings of the combined rhythms of the motor unit firings resemble a noise signal. To the person observing the tracing, however, the effect is like that of an orchestra. From the assembled patterns, the traces of single rhythms could be discerned. With practise, Basmajian's subjects learned to be able to recognise and control single motor unit firings — *voluntary control over the action of a single body cell in isolation*!

The significance of the discovery was not lost upon orthotists, biomechanical engineers, and doctors. The electromyograph had been in use since the '20s as an expensive laboratory tool capable of measuring the activity of the nervous system in controlling the body's movements. By the '60s, however, the devices had become cigarette pack in size and capable of interface with a variety of electronic devices. The myo-electrically (muscle-electrically) controlled prosthesis was born.

From laboratory to rehabilitation centre

The human body is notorious for its ability to reject as "foreign matter" the finest creations of the best-intending implanter. The problems encountered in the kidney have long plagued pioneers in transplant and pacemaker research.

The courtship of medicine and engineering has been equally stormy. Outsiders such as physicists, psychologists and engineers who operate within the inner sanctum of medical care often complain publicly about their 'sidekick' status, minimal financial return from the great health 'pork barrel', and lack of reciprocity in learning the other's secrets.

Even granted the smoothest of inter-professional relations, there is a lengthy process involved in fitting even the simplest of prosthetic devices to the most willing of recipients:

1. **Construction**: devices used in real life must be durable, simple to operate by someone not concentrating, "normal" in appearance, and cheap enough for the disadvantaged recipient to afford.
2. **Fitting**: an orthotic team must ensure that the device is precisely mated to the person's height, weight, shape of limb, and cosmetic needs.
3. **Training**: a team of physiotherapists and occupational therapists must put the recipient through a graduated series of tasks to allow practise in mastering the device. EMG biofeedback provides a bridge between the trainee and his new addition.

The myoelectronic prosthesis is currently only in experimental use. Many of the needs of the handicapped are better served with simpler mechanical limbs, spring-soled shoes and, of course, the ubiquitous wheelchair. But the day may not be far off when the first handicapped person opts for a myoelectric device which gives him abilities he lacked before his accident.

Current prosthetic hand 'replacements' are capable of quite a range of manipulative movement. With improved materials and electromechanical controls employing biofeedback, such prosthetics will improve markedly in appearance and performance.

The electromyogram (EMG)

The electrical output of a muscle derives from the *motor units* which entwine the contracting fibres of the muscles. As a number of motor units fire to contract a muscle, their asynchronous firings resemble a noise signal, modulated in amplitude. Numerous studies have attempted to describe the statistical properties of the complex EMG signal. It may be regarded for practical purposes as:

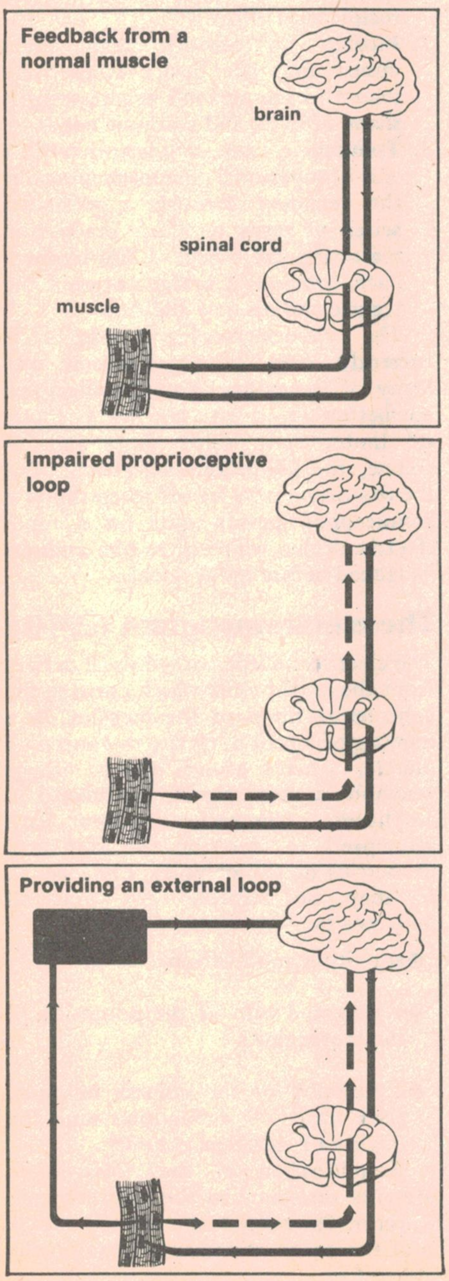
- amplitude modulation
- a weighted sum of the potentials of the motor units
- a function of the number of units, their rate of activation, and the quality of electrical contact

Amplification of the EMG signal presents problems to the amateur constructor. The output of a relaxed muscle is of the order of one or two microvolts ▸

peak to peak. To tap this signal from the skin is no mean feat. The skin is itself a source of electrical activity, whose surface resistance changes with mood (see ETI – 546 galvanic skin response meter, March '77), and a source of a dc potential which can dwarf the feeble EMG signal from beneath.

An amplifier which meets the strict demands of electromyography will probably have some of the following specification:

- common mode rejection of greater than 70 dB
- noise level less than 1 μV p-p
- sensitivity of at least 2 μV p-p
- linearity over the range 1 μV to 10 mV



obtained through a combination of the following features:

- ac coupling,
- a high input impedance (100 K) or 'bootstrapped' differential pre-amp.
- a threshold for amplitude which chops the midportion of the signal, giving greater contrast to small changes in input.
- filtering for mains, radio, and heartbeat frequencies.
- a narrow bandwidth, centred around 200 Hz say 100 Hz to 500 Hz.
- provision for both direct and time-integrated readings to capture both transients and average levels of activity.
- audio and visual output for feedback.

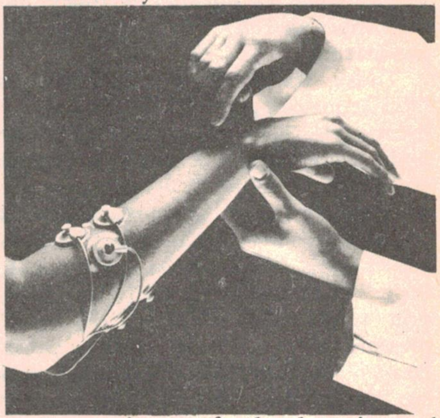
For practical use there are mechanical considerations as well. The electrodes are, of necessity, attached at some point in the system by flexible cable to allow movement by the user. But cable, however well shielded, presents its own problems of noise. One solution is to mount the electrodes, together with a compact preamplifier stage, into a single assembly worn directly on the user. The amplifier, integration, power, switching and output functions, built into a larger box, can then be connected by cable to this tiny system which rides on the body.

Uses of EMG

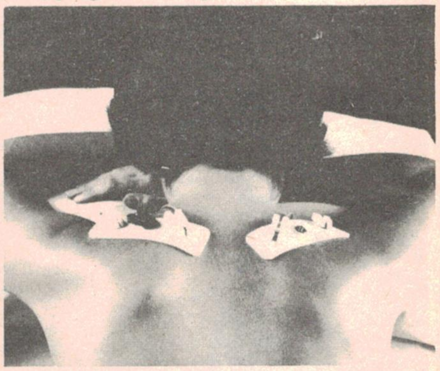
The object of training with an EMG is to begin to recognise the subtle sensations within the body which correspond to tiny variations in muscle activity level. One application is in learning to relax: the subject attempts to "switch off" his central nervous system from movement and sensation in specific areas of the body. This technique has shown promise with a variety of anxiety-based disorders and may benefit Yogi's and athletes who are learning to conserve their energy. At the other end of the spectrum is the need of the physically-handicapped to use the EMG as a sort of 'strength-ometer' for re-training weakened muscles.

Typically, the user applies a conductive gel to the electrode, tapes it to the skin and adjusts the sensitivity of the device, checking the noise level. A popular and practical training procedure is as follows:

1. **Connection to forearm** – flex the fingers and note the electrical activity which corresponds to fine movements; relax the arm by picking it up at the wrist and dropping it, allowing it to flop lifelessly onto the lap; note the sensations as the arm is allowed to become more and more "numb" and "heavy".



2. **Connection to forehead** – raise and lower the eyebrows, frown, squeeze the eyes shut, bite hard: note how all of the facial muscles interconnect; close the eyes and allow the face to become "smooth", listening to the audio feedback as the muscles lose their tightness.
3. **Connection to neck** (cervical or trapezius) – shrug the shoulders, move the head from side to side: note the postures in which the muscle output becomes lowest – slightly drooped shoulders, head balanced vertically; lose that tight feeling in the neck which often accompanies typing or driving.



Having practised the above, the trainee can then strive for more complete mastery of the nervous system: causing tinier and tinier voluntary flickers of movement while remaining relaxed; relaxing quickly after muscular strain; relaxing one portion of the body while tensing another.

Biofeedback is an educational and athletic discipline – there are no unbreakable records, no unbeatable performances, no lack of goals and challenges. No matter how powerful and sophisticated a man's bionic body may become, the challenge of mastery will remain.

Biofeedback will continue to form a bridge between man's mind and his body. ●

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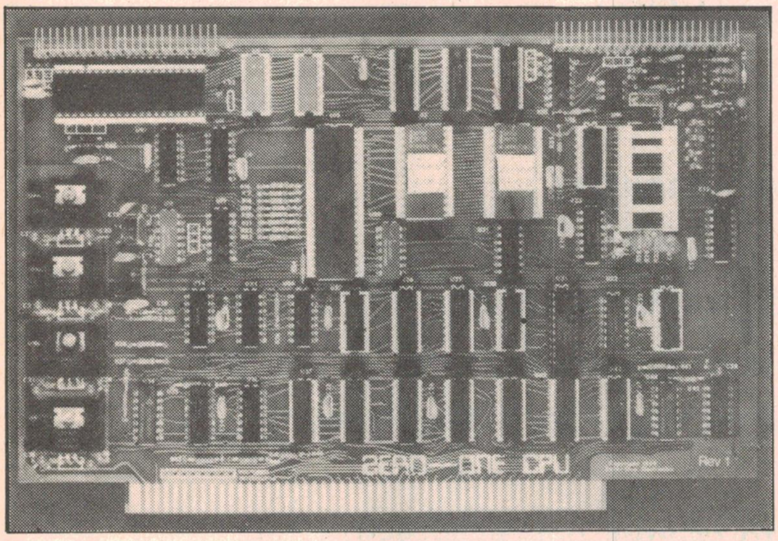

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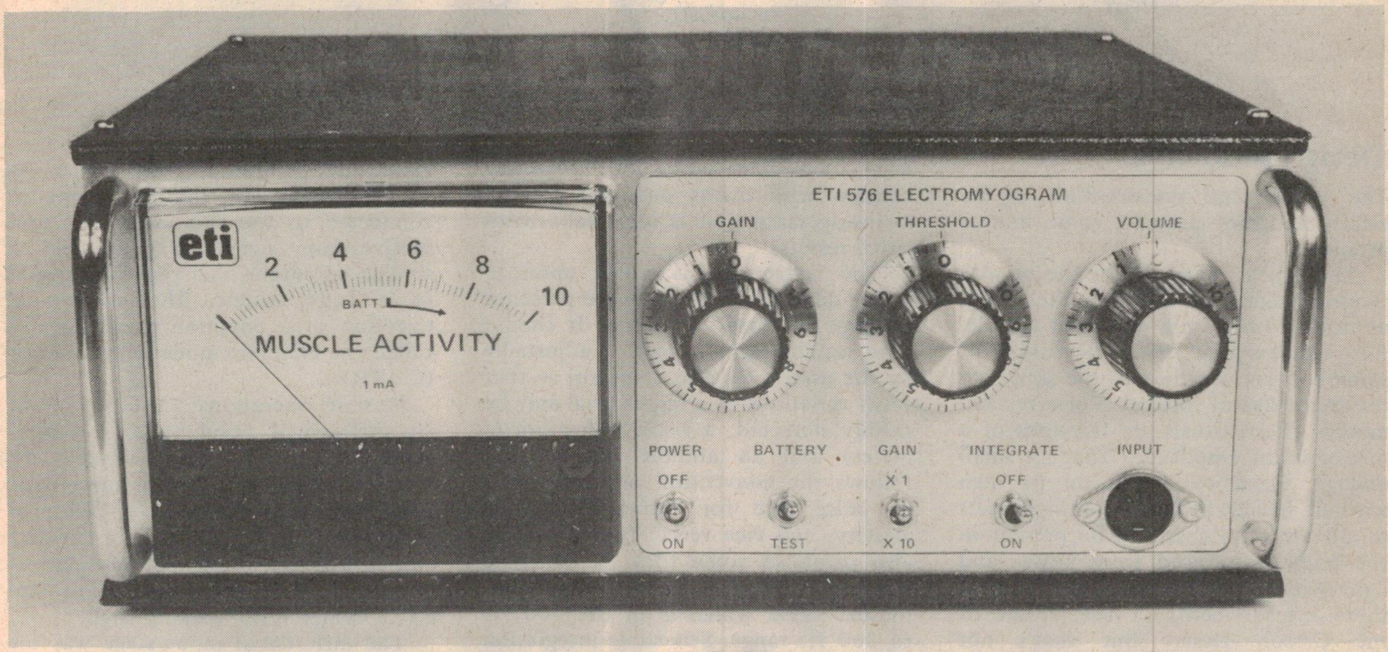
Project 576

Electromyogram for biofeedback use

David Tilbrook

This unit senses the tiny electrical impulses associated with muscle activity and provides an indication of this activity via a meter and a sound output. The latter is a series of pulses, the repetition rate increasing with increased muscle activity, decreasing as muscle activity declines. It may be used to 'train' particular muscles or to learn effective relaxation.



AT THE SUGGESTION of Tom Benjamin, author of the biofeedback feature immediately preceding this article, an electromyogram project was investigated to go hand in hand with the feature on the premise that it's frustrating to read about something that you can't follow up with some practical experiments!

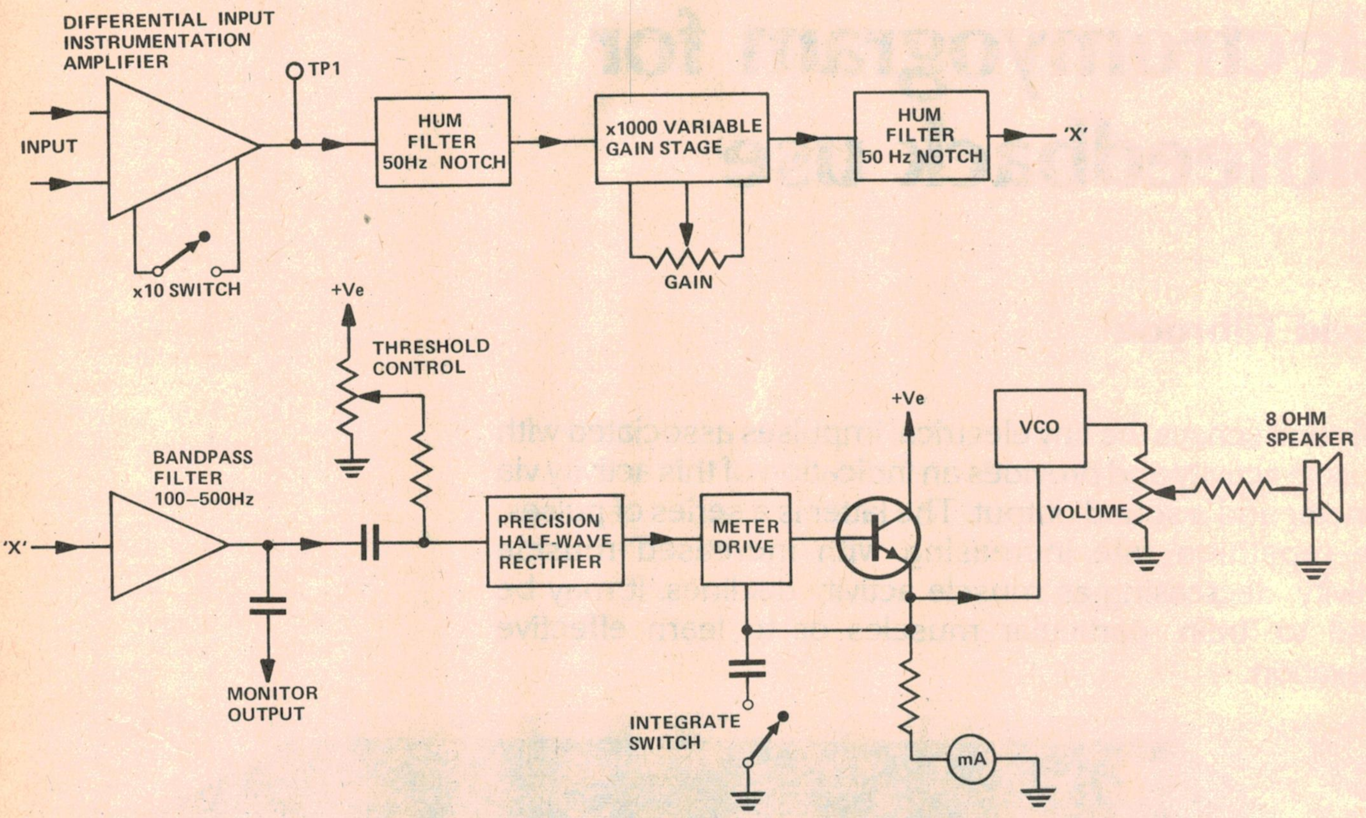
I tackled this project with some enthusiasm as it presented a range of interesting design problems as well as having some pretty tough specifications to meet if the unit was to be at all useful. There's nothing like a challenge to stimulate a little creativity!

We have published two biofeedback projects in the past — the Heart Rate Monitor (ETI 544) in September 1976 and the Galvanic Skin Response Monitor (ETI 546) in March 1977 — but this is the most complex instrument to date. In an article on biofeedback in the September 1977 issue (pages 68 to 72), in discussing EMG devices, the writer said: "This type of instrument is not really suitable for home designing or building".

That little charmer was the first hurdle I had to face.

Before going on to the construction and setting up of the instrument, you may be interested in seeing how this design evolved and why particular circuit techniques were used.

continued p. 36. ▶



Design problems

The design and construction of an electromyogram presents some unique problems.

The object is to detect the minute electrical signals produced by the 'firing' of muscle fibres in a particular muscle. For our purpose metal electrodes of some sort are attached to the skin over the muscle(s) of interest. For a relaxed muscle, these signals are fractions of a microvolt in amplitude. That's a small enough signal to detect on its own without having to find it amongst *volts* of 50 Hz hum that will be present in the body – induced from power and light wiring. Of course, you could do these measurements in the middle of the Gibson Desert but that's not always convenient! You only have to touch your finger to the input of an oscilloscope to get an idea of the magnitude of the hum induced onto the body.

When the body is grounded, this hum will drop to typically one volt peak-to-peak, but trying to see one microvolt in one volt of unwanted noise (50 Hz hum here) sure isn't easy.

The overall block diagram of the unit is shown in the drawing here.

Battery operation is essential as, with any device connected directly to the body, the possibility of accidental contact with mains potential from a mains-operated unit is very real – with lethal results.

The instrument is called upon to detect quite small signals in the presence of large amounts of noise. It should have variable gain control – adjustable by the user, a threshold control so that small variations of a large signal may be readily detected, a visual indication (a meter) and an audible output that follows the convention of rising pitch or pulse rate for increasing muscle activity, and vice versa. Tom Benjamin also mentions some form of bandpass filtering to sort out the predominant muscle signal which is in the 100 Hz to 500 Hz range. Selectable integration of the feedback response is also considered desirable.

First thing was to tackle the hum problem. To overcome this, a number of techniques have been employed. Firstly, I have used a differential amplifier for the input stage. This type of circuit has two input terminals. Signals on the inputs that are *out of phase* will be amplified and passed to the output, while signals that are *in phase* (called common mode signals) will be rejected. The amount of rejection is determined by the amplitude of each in-phase signal. As, in this application, the two inputs are connected to the skin, they will each receive hum signals in phase and of similar amplitude and thus be rejected to a large extent. The amount of rejection of a common mode signal is called the common mode rejection ratio (CMRR).

Most IC operational amplifiers are of the differential input type. A typical op-amp IC has a CMRR of about 90 dB – which means that any common-mode signal will be reduced by a factor of about 30,000. This is good in theory but, in practise, the use of 5% resistors in circuits results in a CMRR of around 60 dB, which is not good enough.

The differential input stage was the most difficult portion of the circuit to design as it was required to have a very high CMRR, a high input impedance and very low noise. Naturally, the home constructor should be able to reproduce the performance of our prototype, preferably without going to a lot of trouble selecting special components or through elaborate set-up procedures. I managed to achieve all these design goals – after discarding several circuits!

The need for a high input impedance is a much-debated subject. Some commercial EMG's boast input

ETI 576 ELECTROMYOGRAM SPECIFICATIONS

Equivalent input noise	150 nV (0.15 uV)
Minimum 50 Hz rejection	80 dB (irrespective of common mode rejection)
Common Mode Rejection Ratio	100 dB or better
Input impedance	220 k
Bandwidth	100 Hz to 500 Hz
Audio output	Variable repetition rate pulse output from inbuilt loudspeaker.
Power source	two 9 V batteries
Power consumption	20 mA per battery
Battery check	battery check switch indicates condition of batteries on meter

impedances as high as 1000 M! The reason is to reduce the effect of poor electrical contact between the electrodes and the skin. In a 1000 M input impedance a few thousand ohms difference between the electrode input impedances (that is, from each electrode to the instrument common or 'ground') goes unnoticed as it represents such a small percentage of the unit's input impedance. Input impedances in this order necessitate MOSFET devices which are relatively noisy in comparison with bipolar transistors at these frequencies.

I elected to use a much lower input impedance and to optimise the noise figure. This has the added advantage that readily available transistors could be used for the input stage.

The input impedance is limited by the base bias resistors of the input stage – in this case, 220 k for each input. At this input impedance, differences in electrode contact resistance with the skin are important, so care should be exercised to minimise this when attaching them.

Biasing the differential input stage is important and this is discussed in the "How it Works" section. One trimpot is used to set up the input stage for correct operation. Once set up, any of the component values may be varied by +/– 10% without affecting the CMRR.

Gain of the input stage is about 1000 (60 dB). Common mode signals will be reduced by the CMRR (about 100 dB, or better), the exact amount of reduction depending on the electrode attachment, as just mentioned, but the CMRR can be degraded quite a bit by this before it becomes a real problem. We experienced little difficulty attaching dry electrodes to dry skin on the forearm.

The choice of this type of first stage has resulted in a very low noise figure. The prototypes (we built two) had measured noise figures close to 150 nV (0.15 uV) at the input. This equals the performance of the best commerical units we have seen.

Immediately following the input stage is a 50 Hz notch filter to offset any increase in hum pickup due to contact resistance variations. This uses the same circuit as our Hum Filter (ETI 451), described in July, but omitting the preset adjustment.

There are two hum filters, we'll get around to the second shortly.

From the first hum filter the signal goes to a variable gain stage. This employs a 741 op-amp, the gain of which is controlled by a potentiometer mounted on the front panel. Gain is variable between 10 and 1000. This stage is fairly straightforward, although the circuit is a little unusual. See "How it Works" for a complete description.

Following this stage is the second hum filter, immediately preceeding the bandpass filter. Signal levels at this stage are around one volt, excess hum on top of this can cause clipping and severe distortion in the succeeding stages.

The bandpass filter is centred at 250 Hz, around the middle of the frequency range of interest. Output from the firing muscle fibres consist of a broad 'noise' signal extending from a little below 100 Hz to about 1 kHz, although the largest amplitude portion of the muscle signal spectrum is between 100 Hz and 500 Hz. The bandpass filter attenuates noise and other signals outside the main area of interest, improving the signal to noise ratio of the instrument.

The output of the bandpass filter is available as a 'monitor output', via a coax socket on the rear panel of the instrument. This enables you to monitor the signal directly using an oscilloscope or via an audio amplifier.

To provide the required audible and visual feedback indications, the signals must undergo some processing to control the appropriate outputs.

From the bandpass filter the signal is mixed with a dc voltage that is varied by means of the Threshold control on the front panel, then fed to a precision half-wave rectifier. This stage rectifies any (ac) signal above the dc voltage set by the Threshold control. By setting the threshold just above the level of noise present, very small changes in muscle activity are made readily apparent. The output of this stage is a series of positive-going pulses from the muscle fibre signal.

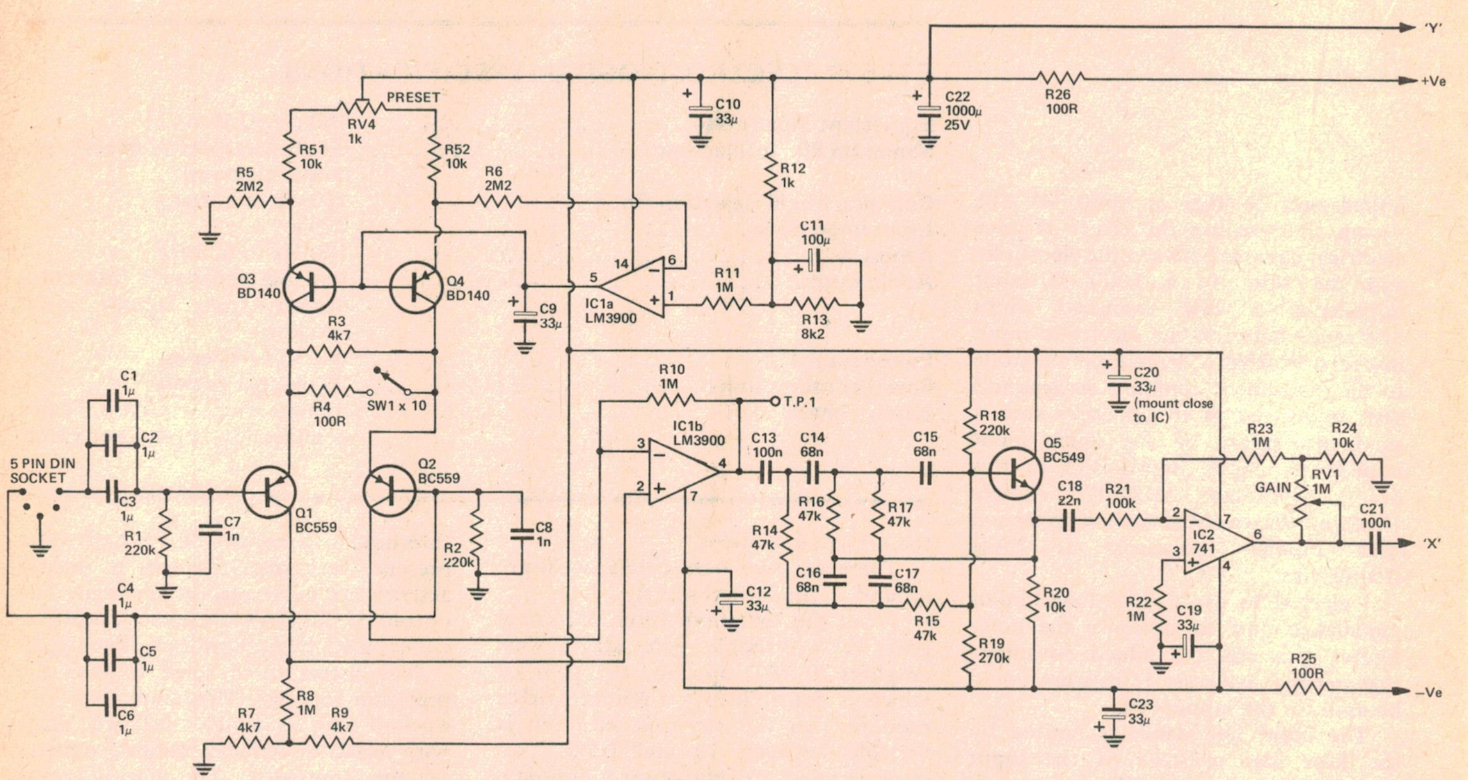
The meter drive stage follows the precision rectifier. This employs a 741 op-amp and an emitter follower stage with negative feedback from the emitter of the transistor. The positive-going pulses from the rectifier stage charge a capacitor, the voltage on this being a measure of the muscle activity as the signal varies above the threshold while the muscle is active.

To provide some integration of the muscle activity level, so that the meter and audible responses are not too rapid (as researchers have found undesirable in some instances), switched capacitors are provided at this point to provide integration times of about 0.5 second and 4 seconds – selected by a front panel switch.

The audible output is derived from the meter drive so that it corresponds with the visual feedback response provided by the meter. This consists of a voltage-controlled oscillator (VCO) that provides a series of pulses to drive a speaker. The VCO employs a 555 timer ic.

Originally, it was intended to use a tone for the audio output. However, battery consumption on the prototype was almost 150 mA – at best! Battery life would be very limited at this consumption. A class A audio output stage is necessary to provide a tone output, and these are quite inefficient. Using a pulse output enabled me to reduce the total current consumption to 20 mA. ▶

Construction details and how to use the machine will appear next issue . . . acts of God, gremlins and the fairies at the bottom of the darkroom permitting!



HOW IT WORKS – ETI 576

Since the circuit is fairly complex, a detailed analysis of its operation is best tackled by looking at the individual stages in turn, from input to output.

Differential input stage

Input signals from sensors on the body drive Q2 and Q1 which are arranged as a differential pair. Emitter current, and thus collector current, for Q1 and Q2 is derived from a precision constant-current source comprised of Q3, Q4 and IC1a. Transistors Q1 and Q2 share the current supplied by the constant-current source. If Q1 (for example) is driven harder, by an input signal, than Q2 then, while the collector current of Q1 increases, there will be a corresponding decrease in the collector current of Q2.

Now, the collectors of Q1 and Q2 are each connected to the input of IC1b, one amplifier in an LM3900 (a quad op-amp package). The amplifiers in the LM3900 package have the special feature that they amplify current **differences** applied to the inputs.

To ensure a high common-mode rejection ratio, the quiescent (no signal) collector currents of Q1 and Q2 must be held very close to a fixed amount. Hence, the precision constant-current source.

To derive this constant current source for Q1 and Q2 the two bases of Q3 and Q4 are driven by the output of IC1a. The non-inverting input (marked +) of IC1a is driven by a fixed voltage derived from a voltage divider (R12, R13) from the positive supply rail. C11 is a bypass capacitor to prevent supply rail variations modulating this reference voltage.

The inverting input (–) of IC1a is coupled to the emitter of Q4 placing this transistor in the feedback loop of IC1a. The op-amp (IC1a) will attempt to maintain the current flowing through its inputs at a constant level, thus maintaining the base-emitter current through Q4, and therefore the collector current, constant at nominally, 100 mA. Assuming Q3 has similar gain to Q4, its collector current will be the same. The 1k preset, RV4, allows adjustment of the two collector currents to offset any slight differences in gain.

The input stage gain is determined by the value of the resistance between the emitters of Q1 and Q2. The lower this resistance, the higher the gain. The 'x 10' switch simply connects a 100 ohm resistor in parallel with R3, increasing the gain.

Capacitors C7 and C8 ensure high frequency stability through bypassing the bases of Q1 and Q2 at frequencies above the range of interest.

To ensure good common-mode rejection ratio, it is essential that the bases of Q1 and Q2 each receive the *same* level of input signal. As the input is ac-coupled the characteristics of the input coupling capacitors must closely match each other. If stranded 10% capacitors are used the slightly different impedances of each will limit the common mode rejection. The solution we adopted was to use several capacitors in parallel so that the slight capacitance variations, and corresponding impedance variations, average out. It is important therefore that these six capacitors, C1-C6, are all the same type.

Supply rail decoupling for the input stages is provided by R25, R26 and C22, C23.

The hum filters

Two 50 Hz hum filters are employed, as can be seen in the block diagram, one immediately following the differential input stage, the other between the variable gain stage and the band-pass filter.

Both 50 Hz filters employ a 'twin-T' circuit — as used in our Hum Filter project, ETI 451, in the July issue. A detailed discussion of this circuit can be found in that article.

In the first hum filter, Q5 is connected as an emitter follower, the twin-T components connected to provide feedback at 50 Hz. In order to obtain a high circuit Q and thus good rejection at 50 Hz, the value of the resistance formed by R16 and R17 (parallelled) must be as close as possible to half the value of R14 and R15. As the latter are 47k resistors, the best way to obtain a value of half that is to connect two 47 k resistors in parallel.

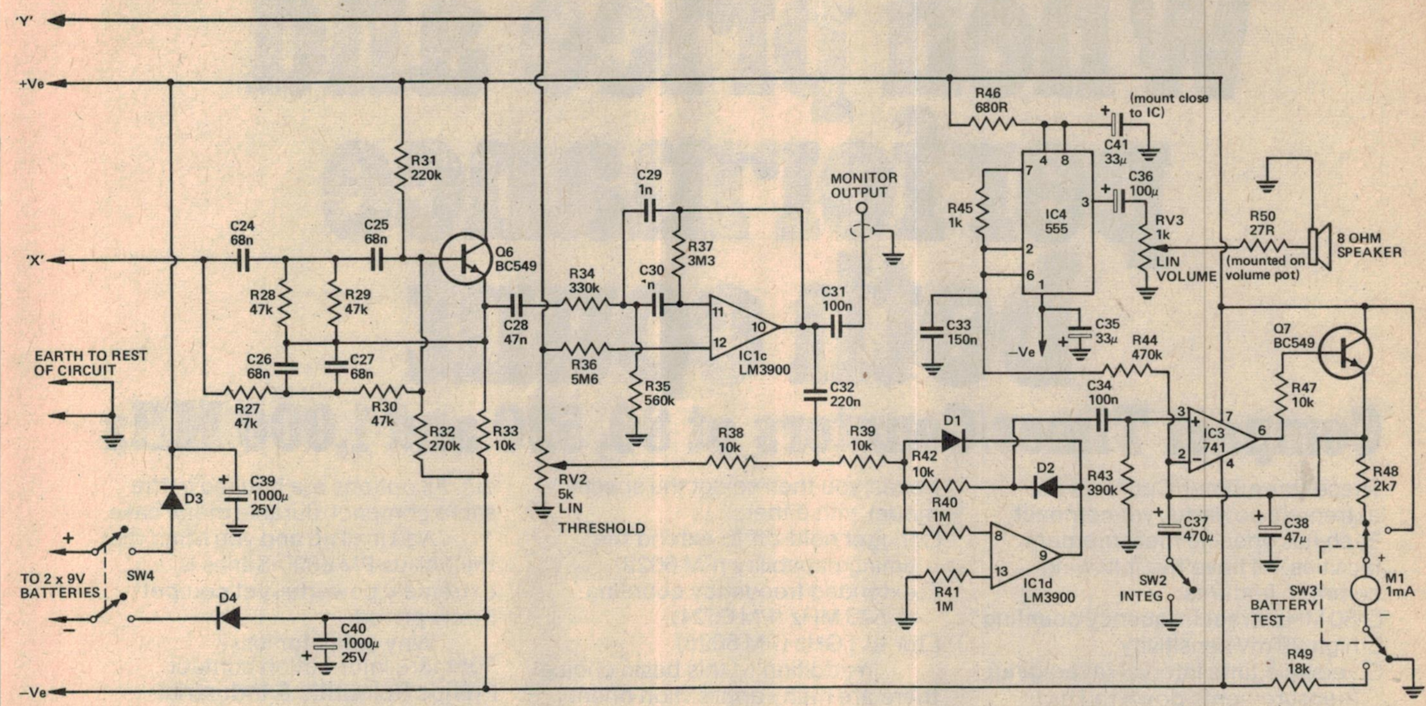
Similarly, for the second hum filter, Q6 is the active component and the filter consists of C24, 25, 26, 27 and R27, 28, 29 and 30. Resistors R28 and 29 form a resistance half that of R27 and 30 to provide good rejection at the notch frequency.

These stages provide a total of 20 dB rejection at 50 Hz.

Variable gain stage

Following the first hum filter is a variable gain stage employing a 741 op-amp. This is quite a conventional amplifier, gain variation being provided by RV1, a 1M potentiometer connected in the feedback path of the 741. RV1 is a front panel control. Gain is variable between 10 and 1000.

To avoid problems arising from large output offset voltages and unstable gain settings, the feedback for the 741 has been arranged via a voltage divider consisting of R23 and R24, the gain potentiometer being connected between the op-amp



output and the junction of these two resistors.

The gain of the circuits is given by the equation:

$$\text{GAIN} = \frac{R_{23} + \dfrac{R_{23}\,RV1}{R_{24}} + RV1}{R_{21}}$$

Bandpass filter

Signal levels at the output of the variable gain stage are around 1 V. Any hum exceeding this level could easily cause clipping in succeeding stages and the purpose of the second hum filter is to prevent this.

The bandpass filter employs one op-amp from the LM3900 package, IC1c. A filter network, consisting of R34, R35 and R37 and C29 and C30, is connected around a feedback path between the op-amp output and its inverting input. This provides a bandpass extending from 100 Hz to 500 Hz which encompasses the range of interest for the muscle fibre signals. At midband (250 Hz), the gain of this stage is roughly four.

A monitor output is taken from the output of IC1c so that the muscle activity waveforms (filtered) may be viewed on an oscilloscope if desired.

Threshold control

This consists of a precision rectifier that passes only the positive peaks of the signal that are greater than a preset dc voltage — determined by potentiometer, the threshold control on the front panel.

The output of the bandpass filter is mixed with a dc voltage derived via the positive supply rail by the potentiometer RV2. The resultant signal — the ac muscle activity signal superimposed on a dc voltage — is then applied to the input of the precision rectifier. This involves IC1d, D1 and D2 and resistors R39, 40, 41 and R42. The latter two resistors convert the current-differencing input of the LM3900 into a conventional voltage-input op-amp.

Positive-going signals of less than 0.6 V above the voltage present on the junction of R39 and R40 will be amplified by the full open-loop gain of IC1d. The output of this stage increases rapidly until D2 conducts, the stage then has only unity gain (x 1), determined by the ratio of R42 and R39.

Output from the precision rectifier is taken from the cathode of D2 and will consist of the amplified, positive-going part of the muscle fibre signals that are above the positive voltage set by the threshold potentiometer, RV2.

Diode D1 ensures that the gain of the stage remains at unity gain for the negative-going portions of the muscle fibre signals from the output of IC1c.

Meter drive

This consists of an op-amp (IC3) with an emitter-follower stage (Q7) connected in the negative feedback path. The emitter of Q7 drives the meter.

The threshold stage output is coupled to the input of IC3, a 741, via a 100n capacitor, C34. Resistor R47 limits the base current of Q7 to a safe value as the 741 will provide much more current than the transistor will stand! A signal from the output of the threshold circuit will be amplified by IC3, causing Q7 to turn on, charging C38. The meter is connected to 'read' the charge on C38, via R48. The more signal that appears above the threshold, the longer Q7 will be turned on, increasing the charge in C38, thus increasing the meter reading. The circuit will respond quickly to increasing input signals, showing a corresponding increase in the meter reading. As the signal decreases, with decreasing muscle activity, the meter reading decays at a rate depending on the capacitance between the emitter of Q7 and ground. This provides for some integration of the signal level variations.

The integrate switch, SW2, connects a 470 μF capacitor C37) in parallel with C38 (47 μF). With this in circuit (integrate switch 'on'), the meter takes some four seconds to drop from full scale to zero.

Voltage-controlled pulse generator

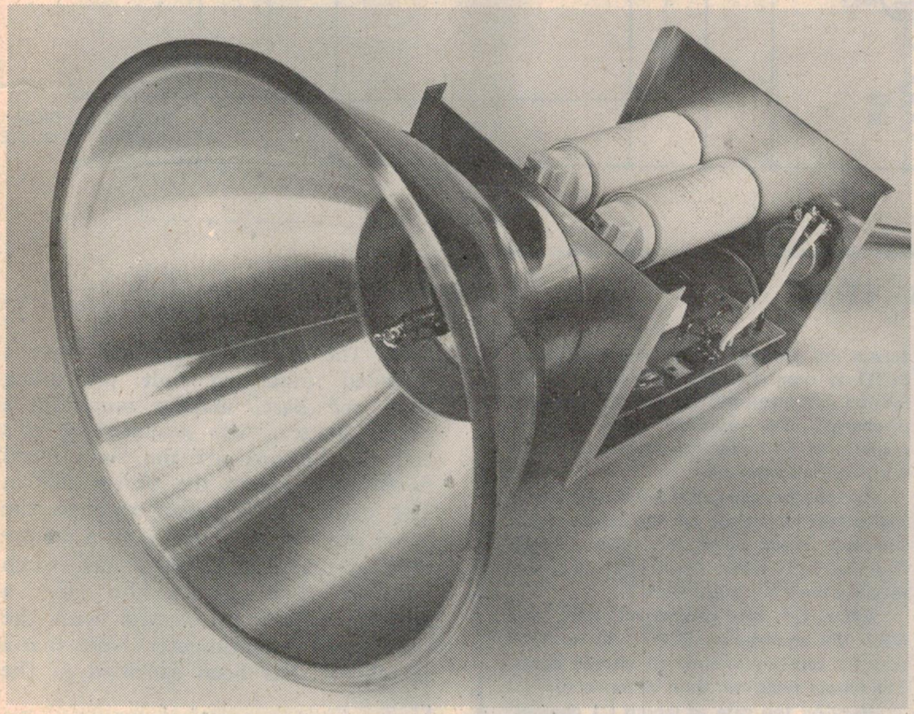
This provides an audio output, consisting of a series of pulses, the repetition rate being an indication of muscle activity.

The emitter of Q7 is coupled to IC4, a 555 timer, via R44. Current through this resistor charges C33 until the voltage on pin 6 of IC4 reaches 2/3 of the voltage on pins 4 and 8. At this point, pin 7 of the 555, previously appearing as an open circuit, will conduct discharging C33 via R45. Once the voltage on pin 2 drops below 1/3 of that on pins 4 and 8, pin 7 returns to an open circuit condition, allowing C33 to charge again. In this manner, the 555 oscillates providing pulses on pin 3 to the speaker, via RV1 which serve as a volume control. As the voltage at the emitter of Q7 varies according to the variation in muscle activity signals, the rate at which C33 charges will vary. This varies the pulse repetition rate of the 555 oscillator in sympathy with the variations in muscle activity.

Disco strobe light

We published our first strobe unit way back in August 1971. It has been one of our all-time popular projects. This unit is an up-dated version featuring a number of improvements.

Phil Wait



STROBE LIGHTS are very popular as lighting effects devices at parties and discos. Emitting a series of bright flashes of light several times per second, the movement of dancers takes on a jerky 'stop-motion' effect. Used in conjunction with coloured 'light show' effects units that vary the colour and intensity of a bank of lights, the overall effect achieved can be quite stunning.

We first published a strobe unit for this application back in August 1971. That was the ETI 505 High Power Strobe. It has been by far the most popular project we have ever described. The ETI 505 was still available as a kit – and a steady seller by all accounts – quite recently.

When the demand for a new strobe became apparent earlier this year, we sat down and took a long hard look at the original design. But despite all the revolutionary technology that has appeared since then, there was no way we could see of significantly altering the device to any advantage. That original design was just about the simplest, least expensive and most effective for a strobe that could be devised. However, experience over the years showed up a number of minor shortcomings and we have modified the circuit to eliminate these – and this Disco Strobe is the result.

The effect

How does a strobe produce the 'stop-motion' effect? Quite simply, really. At each flash of light, in a darkened room, you will see everybody in the position they are in at the instant of the flash. During the short interval before the next flash, they will have moved and you will see them in a slightly different position, and so on.

Thus, it seems they 'jump' from position to position and anything or anybody that moves does so in the characteristic jerky fashion. If the flash rate of the strobe is fairly close to the rhythmic movements of the dancers, the effect is quite dramatic.

Improvements

There were a couple of points on which we though the old strobe could be improved. Firstly, some constructors reported intermittent false triggering of the strobe tube, resulting in a disturbing 'flutter' in the flash rate. In the original circuit, the gate of the SCR pulsing the strobe tube was connected directly to the two neon trigger tubes with no resistor from the SCR gate to ground. Without being 'clamped' to ground by a resistor, the sensitive SCR gate is prone to being triggered by mains-borne noise 'spikes' capacitively coupled to it via the neon tube or adjacent circuitry. This has been corrected in the current project.

The second point was more of a construction problem. The capacitor charging circuit and the flash timing circuit on the original strobe were each powered by separate half-wave rectifiers. Now that appears like a full-wave bridge rectifier with the bridge not completed. Many constructors saw this and immediately took it to be a mistake – so they 'put it right' by connecting the cathodes of D3 and D4 in that circuit. The result was always disastrous! Our sympathies to those who were caught.

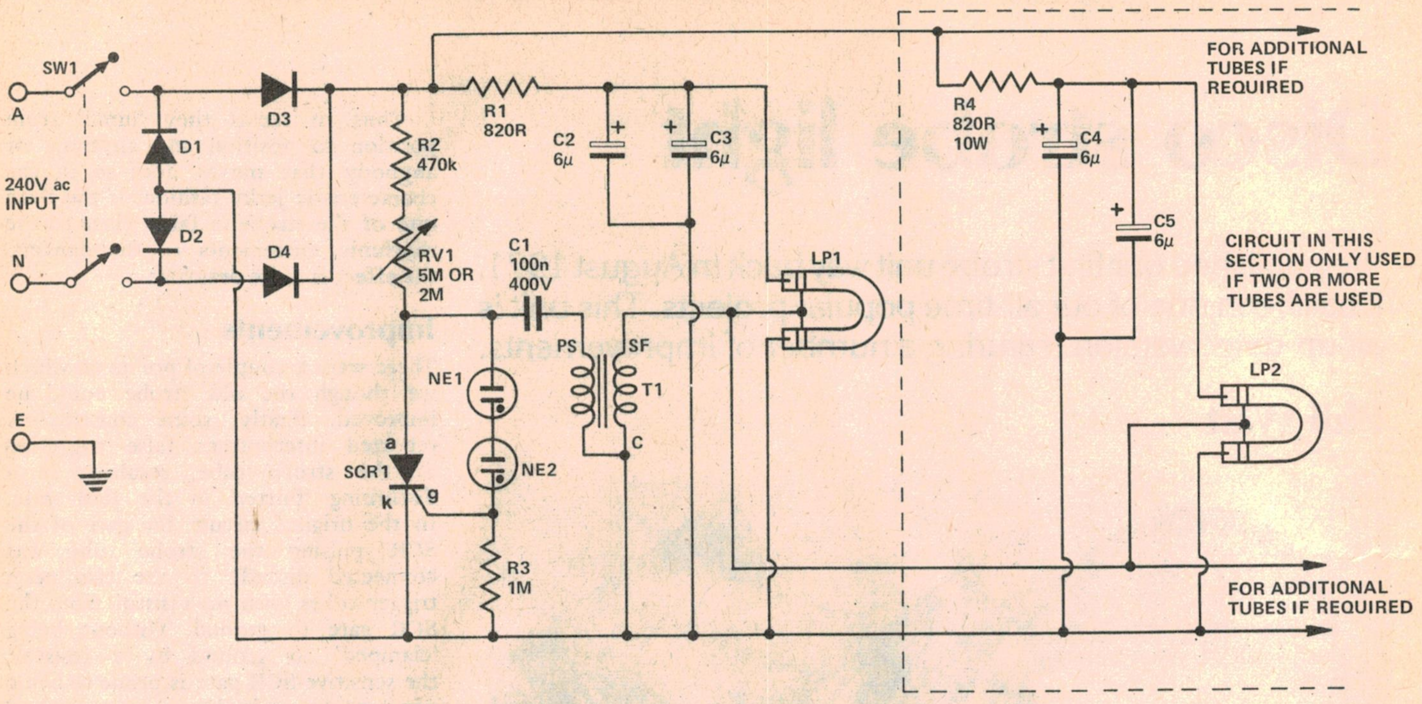
To avoid this occurring again we decided to use a conventional bridge rectifier to power the complete circuitry.

Construction

Carefully examine the photographs and the construction diagrams. Assembly is quite straightforward and little difficulty should be experienced. Care must be taken with the wiring though, as the unit operates directly from the mains.

The electronics is all mounted in a 145 x 115 x 90 mm aluminium box. A 180 mm diameter spun aluminium reflector is mounted on one end, the strobe tube(s) being mounted inside this by a plug and socket arrangement. An octal valve socket is used, its mounting screws being used to secure the reflector to the box.

At the opposite end of the box, the discharge capacitors are mounted, two or four being used depending on whether one or two strobe tubes are ▶



HOW IT WORKS – ETI 574

The principle of operation of the strobe tube is discussed in the general text, so here we'll concentrate on the overall circuit.

The mains voltage is rectified by a diode bridge circuit formed by D1, D2, D3 and D4. Since there is no capacitor directly across the dc output of the bridge rectifier, the output consists of a series of half-wave pulses at a frequency of 100 Hz (i.e.: twice the mains frequency). The storage capacitors, C2 and C3 (plus C4, C5 etc if extra tubes are added) are charged from the bridge rectifier output via R1 (R3 etc for extra tubes). They will charge to the peak value of the rectifier output, about 340-350 volts. (That is, 1.414 times the mains voltage: 240 x 1.414 = 339 volts).

The resistor in series with the storage capacitors (R1, R3) limits the peak charging current to prevent damage to the rectifier diodes and also serves to isolate the strobe tube from the mains.

The two neon 'trigger' lamps, NE1 and NE2, each have a 'striking potential' of around 120 volts. That is, the neon gas inside will ionise, ('break down') and the lamp 'fires', conducting current very suddenly when this striking voltage is reached or exceeded.

Now, C1 is charged from the bridge rectifier output via R2 and RV1. As the voltage across C1 rises it will eventually reach the striking voltage of the two neons. As these are in series, the voltage across C1 must reach about 240 volts before they strike. When this occurs, a pulse of current will flow into the gate of SCR1, causing it to conduct. This effectively places C1 across the primary of T1 as the anode of SCR1 is then connected to earth for all intents and purposes. C1 will then rapidly discharge, the resulting pulse in the primary of T1 being transformed to about 4 kV at the secondary.

As the secondary of T1 is connected to the trigger electrode of the strobe tube, this will 'break down' and emit a bright flash of light when the trigger electrode receives the 4 kV pulse from T1.

After C1 has discharged, NE1 and NE2 will extinguish, SCR1 will turn off and C1 will commence to charge again. The whole cycle will then be repeated.

Varying the rate at which C1 charges, and thus the amount of time it takes to charge C1 to about 240 volts, will vary the time between flashes. Thus RV1, a 2 M or 5 M potentiometer, serves as a 'flash speed' control. Increasing the resistance of RV1, increases the time it takes C1 to charge to 240 volts, increasing the time between flashes – which decreases the flash rate.

The storage capacitors, C2 and C3 (with one tube), discharge when the strobe tube fires, recharging between successive flashes.

When two (or more) tubes are used, each must have a separate storage capacitor (made up of two capacitors here, for convenience) and limiting resistor, otherwise – as explained in the text – the first tube to fire in a parallel-connected arrangement would prohibit the other tube(s) from firing.

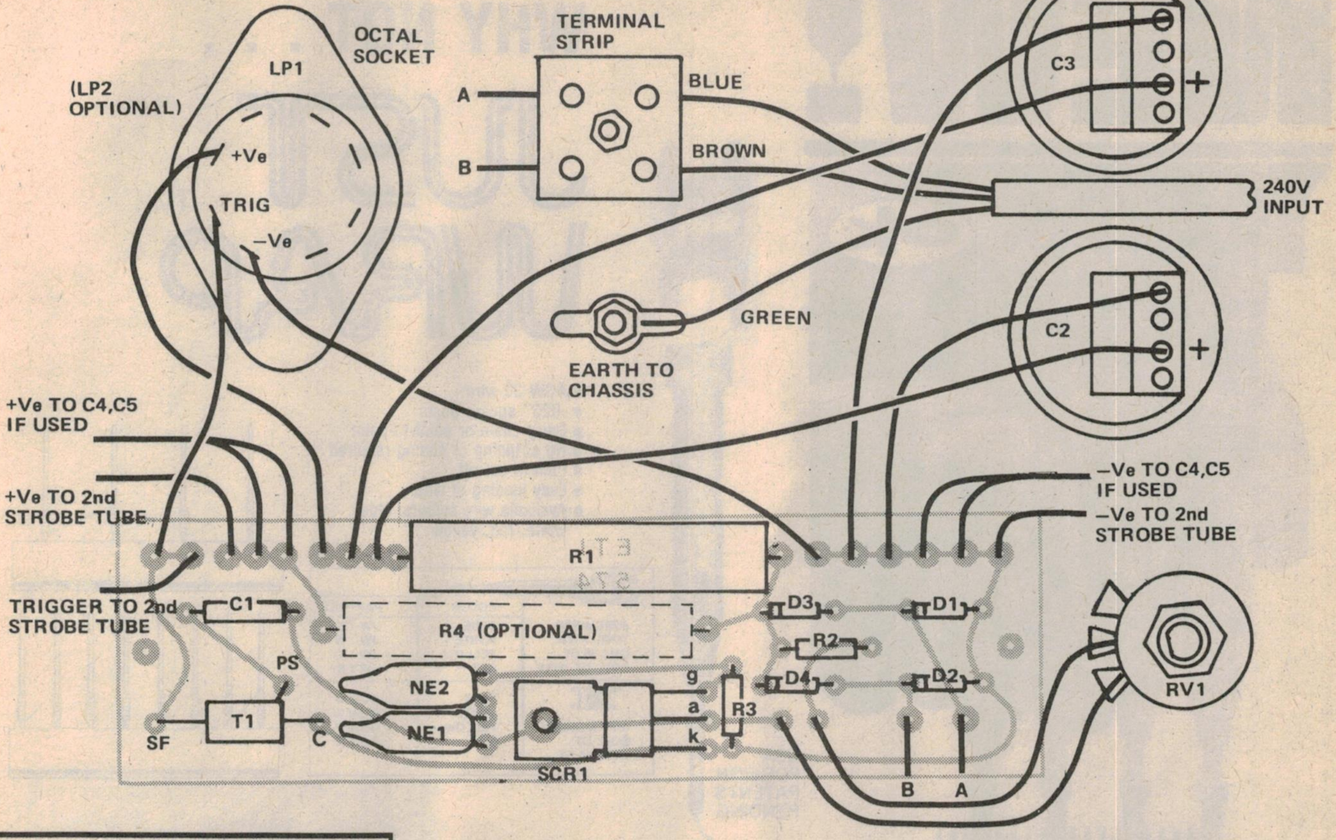
The resistor between the gate of SCR1 and ground, R4, prevents spurious triggering of SCR1.

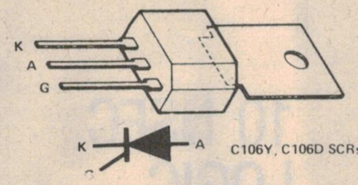
used. The capacitors specified have a threaded mounting bolt protruding from the base, making mounting a simple matter. Also mounted on this end of the box are the flash speed potentiometer and the power switch. The power cord passes through the panel also, being secured by a clamp-type grommet. A two-pole mains switch must be used and can be either a separate switch or integral with the flash speed potentiometer. Note that a switch-pot. has been specified in the parts list.

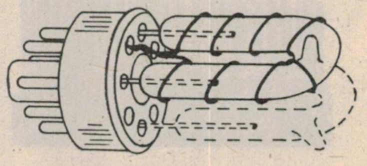
If one strobe tube is used, only two capacitors will be required. These should be mounted, so that two more may be mounted at a later stage if another strobe tube is added. The potentiometer may have a value of either 5M or 2M, depending on which is the more readily available. The 5M pot. will give a speed from about one flash per second to about 20 flashes per second. The slowest speed is somewhat too slow for most applications, but this matters little as the desired flash rate will be within the general speed range in any case. The 2M pot. gives a range of about two or three flashes per second up to about 20 flashes, as before.

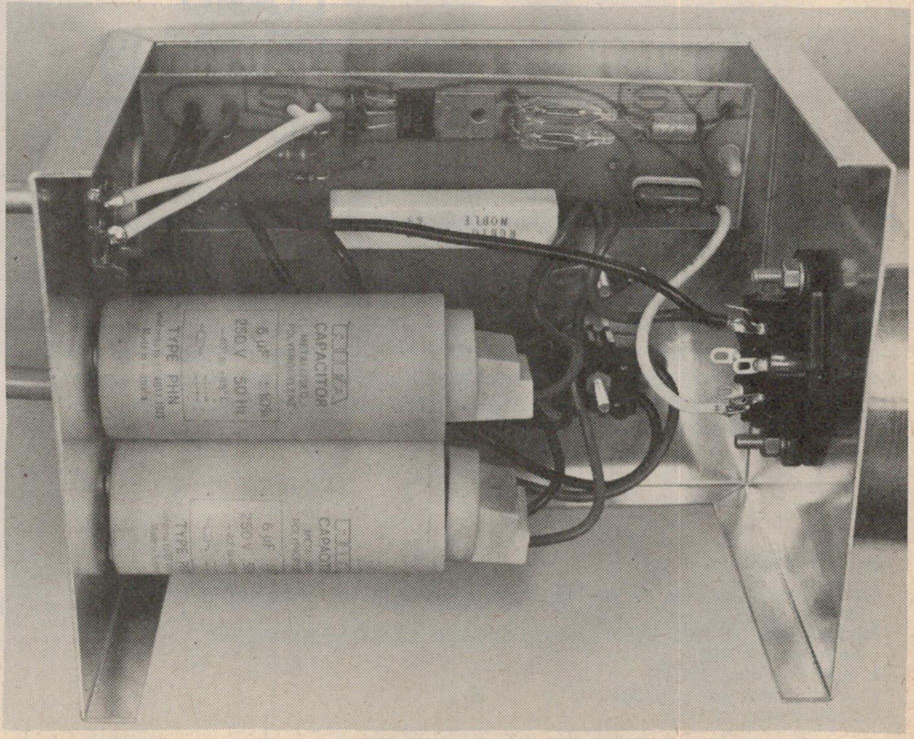
Whatever you do, do not omit the plastic cover over the front of the reflector. This is to prevent accidental contact with the flash tube and the lethal voltages present.

The pc artwork is on page 83.









PARTS LIST – ETI 574

Resistors
R1 . . . . . . .820R 10W
R2 . . . . . . .470k ½W
R3 . . . . . . .1 meg
R4* 820R 10W
RV1 . . . . . .2M or 5M linear potentiometer with double pole switch (see text)

Capacitors
C1. . . . . . . .100n 400Volt polycarbonite
C2,C3,C4*, C5* . . . . . 6µF 240Vac capacitor (RIFA type PHN)

Semiconductors
D1-D4 . . . . .EM4004,EM404, A14A or sim.
SCR1 . . . . . .C106D,BT100A 500R, or sim.

Miscellaneous
NE1,NE2. . . .neon indicator tube GE - NE2
LP1,LP2* . . .Strobe tube, Circuit Components type MFT 1210 or Dick Smith type.
T1. . . . . . . .pulse transformer to suit tube type TR4KN or sim.
Octal Plug . . .McMurdo L8USR1

Octal Socket McMurdo type RT8, reflector, metal box 145 mm x 115 mm x 90 mm, perspex cover, hinge, magnetic catch, power cable, ETI 574 pc board.

*Components marked with an asterisk are only used for two tubes.

Caution!

The entire circuit is at mains potential (including the tube) and, if you don't want to fry yourself – or be responsible for somebody else accidentally doing likewise – it is essential that the case be securely earthed. The power cord must be arranged and secured strictly as shown in the diagrams. Use proper 240 Vac rated wiring (23-0076 PVC insulated) for all connections. For safety's sake, a perspex cover is bolted over the open end of the reflector.

Assemble the printed circuit board according to the overlay, noting the polarity of the diodes. If two strobe tubes are to be used, include the additional 820 ohm, 10 watt resistor as shown.

Plastic standoffs must be used to mount the pc board. These standoffs decrease the chance of a short to the metal case. They are necessary secondly because the trigger transformer develops 4 kV pulses which could possibly develop arcs across the pc board should metal standoffs be used.

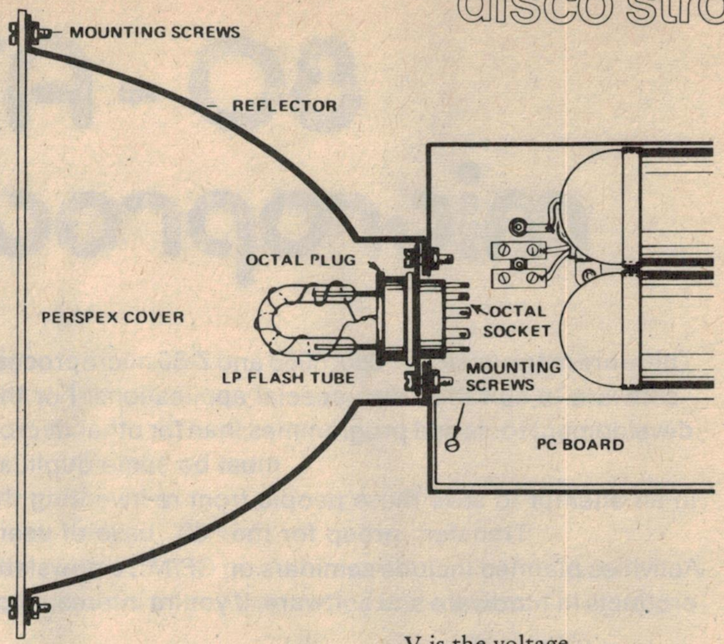
The strobe tube itself is not a critical component. Two types are commonly available. The type MFT1210 from Circuit Components of Bexley NSW is one such unit. Another is that advertised by Dick Smith, (catalogue No. S-3882).

Neither of these tubes includes a trigger electrode, so one must be attached. This is simply made by winding a length of 22 gauge (or some gauge thereabouts) tinned copper wire around the glass and taking it down to a spare pin in the octal base on which the strobe tube is mounted. The diagram shows how one or two tubes, together with their trigger electrodes, are mounted in the octal plug.

When you have the assembly complete make sure all components are securely mounted and there are no short circuits – or any possible – and **RE-CHECK THE EARTH CONNECTION.**

The smoke test

Perhaps that's a little too strong! Nevertheless, once you have the unit assembled and carefully checked, set the speed potentiometer to minimum flash rate (fully anticlockwise), plug in and switch on. If all is well, the strobe should flash about once per second or a little faster, depending on which value pot. is installed. Advancing the control should increase the flash rate.



How the strobe tube works

For those not familiar with a strobe tube and the way it works, the following explanation should, er . . . throw some light on the subject.

A strobe tube is a simple tube of glass, sealed at the ends and bent into a convenient shape, evacuated and then filled with a tiny amount of one of the rare gasses – in this case Xenon. Small metal electrodes are sealed in the ends of the tube, projecting into the interior. A third, 'trigger' electrode is attached in some manner around the outside of the tube, though not completely covering it. Some 300 to 500 volts dc is applied between the two end electrodes, generally from a storage capacitor, but the resistance of the gas is very high at this stage and negligible current will flow. When a very high voltage pulse, about 4 kV, is applied to the trigger electrode, the gas inside the tube ionises ('Breaks down'), its resistance falling quickly to a very low value. The storage capacitor discharges through the tube and an enormous current flows – amps of it! – the voltage across the electrodes falling in about 100 microseconds to a value below that necessary to maintain the gas ionised. When the gas ionises it emits an intense burst of light, extinguishing when the discharge ceases.

The amount of light produced during each flash is dependant on the value of the discharge capacitor and the voltage across it. For those interested, the formula for the energy of the discharge is:–

$E = \frac{1}{2}CV^2$

where E is the discharge energy, in joules
C is the capacitance in Farads
V is the voltage

Increasing either the capacitance or the voltage will increase the energy of the discharge, and hence the light output. However, as the output is increased, tube life falls off dramatically.

A better way to obtain more light output is to use two tubes. Separate storage capacitors are necessary as each tube varies with regard to discharge characteristics. If two tubes are simply connected in parallel, whichever commences to discharge first – even though it may only be microseconds earlier – will prevent the other tube from firing.

In the circuit used for this strobe unit, two 6 uF capacitors are used in parallel for the storage capacitor. For two tubes, another two capacitors are used. The same trigger transformer may be used to trigger both tubes in a twin-tube model.

For small rooms or total darkness, the light output of a single tube unit will be more than adequate. For larger rooms, halls etc, two tubes will be necessary.

WARNING

Repetitive pulses of light – especially around nine flashes per second – may cause epileptics to have convulsive seizures.

Those prone to grand mal, or psychomotor attacks should avoid areas where strobe lights are operating. In fact, most people will suffer nausea or headaches after long exposure to a strobe.

In the event of an attack whilst the strobe light is operating, it must be turned off immediately.

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LM349N	1.45
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LF357N	.90
LM358N	.60
LM370N	2.50
LM373N	3.30
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LM381N	1.50
LM382N	1.30
LM386N	.90
LM387N	1.10
LM391N	1.40
LM393AN	.70
555	.25
556	.60
LM565CN	1.10
LM567CN	1.20
TBA641-BX1	2.00
LM709-CN	.50
UA710CA	.55
723	.40
LM723CH	.54
LM733CN	.75
741	.20
UA747PC	.85
LM748CN	.45
LM1458N	.50
LM2902N	1.20
LM3039H	.78
CA3065	.50
CA3130	1.05
CA3140T	1.05
UA3401	.60
LM3900N	.65
LM3909N	.85
LF13741N	.50
LF13741H	.50

TRANSISTORS

2N301	1.80
2N1711	.45
2N2219A	.35
PN2222	.18
2N2222	.20
2N2646	.55
2N2647	.90
2N2904	.40
2N2905	.35
2N2906	.30
2N2907	.25
2N3053	.35
2N3054	.60
2N3055	.45
2N3563	.18
2N3564	.25
2N3565	.18
PN3566	.18
PN3567	.18
PN3568	.18
2N3569	.18
2N3638	.18
PN3638	.18
2N3638A	.21
PN3642	.14
PN3643	.16
PN3644	.16
PN3645	.16
2N3646	.16
2N3694	.10
2N3702	.20
2N3704	.25
2N3819	.25
2N3904	.18
2N3906	.16
2N4032	.45
2N4033	.80
2N4250	.12
2N5458	.40
2N5459	.40
AC127	.80
AC128	.60
AC187	.65
AC188	.65
AD149	1.60
AD161	1.35
AD162	1.35
AY6112	.40
AY6119	.40
AY6120	.40
AY6121	.40
AY8110	.50
AY8139	.40
AY9139	.40
BC107	.18
BC108	.18
BC109	.18
BC147	.10
BC177	.20
BC178	.20
BC179	.20
PC208	.15
BC547	.12
BC548	.12
BC549	.12
BC557	.14
BC558	.14
BC559	.14
BD137	.35
BD138	.35
BD139	.26
BD140	.26
BD234	.41
BD237	.47
BF115	.45
BF173	.60
BF180	.35
BF198	.10
BF199	.10
BFY50	.26
BSV17	.65
BU126	2.45
BUX80	6.75
FT2955	1.15
FT3055	.65
MEL12	.75
MJ802	2.95
MJ2955	.60
MJE2955	1.20
MJE3055	1.20
MPF102	.35
MPSA05	.18
MPSA14	.24
OA675	.10
OC910	.60
OC912	.60
OC925	.10
SE1010	.18
TIP31A	.40
TIP32A	.40
2SD200	1.00
TIP2955	.70
TIP3055	.65

TTL 7400 SERIES

7400	.14
7401	.16
7402	.14
7403	.18
7404	.16
7405	.20
7406	.18
7407	.30
7408	.16
7409	.20
7410	.14
7411	.22
7412	.26
7413	.28
7414	.32
7416	.40
7417	.40
7420	.16
7421	.16
7423	.35
7426	.24
7427	.24
7430	.16
7432	.24
7437	.30
7438	.30
7440	.20
7441	.90
7442	.35
7443	.65
7444	1.20
7447	.50
7448	.50
7450	.18
7451	.18
7453	.20
7454	.18
7470	.35
7472	.30
7473	.30
7474	.25
7475	.25
7476	.25
7480	.60
7485	.85
7486	.36
7490	.24
7491	.50
7492	.26
7493	.26
7494	.80
7495	.35
74107	.40
74121	.36
74122	.60
74123	.30
74126	.50
74132	.75
74145	.80
74150	.65
74151	.36
74153	.65
74154	.65
74157	.45
74160	.60
74164	.55
74165	.55
74175	.75
74192	.65
74193	.65
74221	.75
74365	.75
74367	.55

CMOS

4000	.20
4001	.18
4002	.18
4006	1.05
4007	.20
4008	1.00
4009	.65
4010	.65
4011	.18
4012	.18
4013	.42
4014	1.00
4015	1.00
4016	.41
4017	1.05
4018	1.00
4019	.52
4020	1.05
4021	1.05
4022	1.05
4023	.18
4024	.70
4025	.18
4026	1.55
4027	.60
4028	.78
4029	1.10
4030	.33
4040	.95
4041	.80
4042	.80
4043	.85
4044	.85
4046	1.30
4049	.40
4050	.40
4051	.70
4052	.70
4060	1.30
4066	.65
4068	.29
4069	.18
4070	.27
4071	.27
4072	.27
4073	.27
4075	.27
4077	.27
4078	.27
4081	.27
4082	.27
4093	1.30
40174	1.05
4510	1.05
4511	1.05
4518	1.05
4519	.65
4520	1.05
4541	1.30
4560	2.60
74C00	.22
74C02	.22
74C04	.22
74C08	.22
74C10	.22
74C14	.40
74C20	.25
74C30	.25
74C32	.25
74C48	1.40
74C73	.65
74C74	.65
74C76	.65
74C83	1.25
74C85	1.10
74C90	.85
74C93	.85
74C95	.55
74C107	.60
74C150	2.40
74C151	1.50
74C160	.80
74C162	.80
74C175	.80
74C192	1.10
74C193	1.10
74C195	.90
74C221	1.30
74C373	1.60
74C901	.50
74C902	.50
74C907	.50
74C925	4.10
74C927	4.10
80C95	.60
80C97	.60
80C98	.60

TTL 74LS SERIES

74LS00	.15
74LS01	.20
74LS02	.15
74LS03	.18
74LS04	.18
74LS05	.18
74LS09	.18
74LS10	.18
74LS11	.18
74LS14	.70
74LS20	.18
74LS21	.18
74LS22	.22
74LS26	.28
74LS27	.18
74LS28	.30
74LS30	.22
74LS32	.22
74LS33	.32
74LS37	.30
74LS38	.30
74LS40	.18
74LS42	.75
74LS51	.25
74LS54	.25
74LS55	.25
74LS73	.50
74LS74	.40
74LS75	.45
74LS85	.95
74LS86	.35
74LS90	.45
74LS92	.80
74LS93	.65
74LS107	.35
74LS109	.35
74LS112	.35
74LS123	.90
74LS125	.55
74LS126	.55
74LS132	.80
74LS138	.80
74LS151	.60
74LS154	1.20
74LS157	.60
74LS163	.70
74LS174	.60
74LS175	.60
74LS190	.95
74LS192	.70
74LS193	.70
74LS196	.90
74LS221	.90
74LS257	.50
74LS365	.55
74LS366	.55
74LS367	.55
74LS368	.55
74LS374	1.40

S.C.R.

C106Y	.30
BT100A300R	.50
C106D1	.50

DIODES

1N914	.04
1N4001	.06
1N4004	.06
1N4007	.12
1N5625	.35

ZENER DIODES

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7806	1.00
7808	1.00
7812	.70
7815	1.00
7824	1.00
7912	1.10
7915	1.10
78L05	.35
78L12	.35
78L55	.35
79L05	.60
79L12	.60
79L15	.60

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CLIPS	.02

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.22 uf 25 V	.07
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1 uf 6.3 V	.07
1 uf 50 V	.07
1 uf 63 V	.07
2 uf 10 V	.07
2.2 uf 16 V	.07
2.2 uf 35 V	.07
2.2 uf 50 V	.07
3 uf 300 V	.12
3.3 uf 16 V	.07
3.3 uf 25 V	.07
3.3 uf 50 V	.07
4.7 uf 10 V	.07
4.7 uf 25 V	.07
4.7 uf 250 V	.12
4.7 uf 315 V	.12
5 uf 3 V	.07
6.8 uf 10 V	.07
10 uf 16 V	.07
10 uf 25 V	.07
10 uf 120 V	.12
22 uf 25 V	.10
22 uf 50 V	.10
22 uf 120 V	.12
22 uf 250 V	.19
25 uf 25 V	.10
25 uf 63 V	.12
25 uf 300 v	.15
33 uf 6.3 V	.07
33 uf 10 V	.07
33 uf 25 V	.07
33 uf 50 V	.12
33 uf 160 V	.19
33 uf 200 V	.19
33 uf 250 V	.19
47 uf 6.3 V	.07
47 uf 10 V	.09
47 uf 16 V	.09
47 uf 25 V	.10
47 uf 63 V	.12
80 uf 10 V	.09
80 uf 16 V	.12
100 uf 3 V	.07
100 uf 6.3 V	.07
100 uf 10 V	.09
100 uf 16 V	.12
100 uf 35 V	.15
100 uf 63 V	.18
150 uf 3.15 V	.07
200 uf 6.3 V	.12
200 uf 10 V	.12
200 uf 12 V	.12
200 uf 15 V	.18
220 uf 6.3 V	.09
220 uf 10 V	.12
220 uf 16 V	.14
220 vf 25 V	.15
220 uf 35 V	.19
220 uf 50 V	.23
220 uf 63 V	.23
330 uf 10 V	.15
470 uf 16 V	.19
470 uf 25 V	.19
470 uf 35 V	.31
500 uf 10 V	.15
640 uf 16 V	.19
1000 uf 6.3 V	.19
1000 uf 10 V	.19
1000 uf 16 V	.22
1000 uf 18 V	.22
1000 uf 25 V	.30
1000 uf 35 V	.30
2200 uf 10 V	.30
2500 uf 16 V	.60

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1500 uf 35 V	.60
2500 uf 35 V	1.10
2500 uf 63 V	1.60
2500 uf 80 V	1.75
3300 uf 50 V	1.60
3300 uf 75 V	2.70
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Get going on radioteletype

Tom Moffat VK7TM 39 Pillinger Drive Fern Tree, Tas. 7101

This is Tom's second article in a short series on how to get going on radioteletype — an intriguing facet of communications. This month the transmitter modulator is described.

LAST MONTH we described the circuitry to get a teletype machine receiving signals off-air. This month we'll go into the transmitting side with a tone modulator board that generates the two standard tones, commonly used by radio amateurs, of 2125 and 2295 Hz. Even if you don't intend to transmit, this tone modulator will be useful for recording teletype signals on cassette tape. The board also includes a transmitter keying relay to control several transmitters.

There are two ways to frequency shift key an HF transmitter with a teletype signal. One is to transmit a steady unmodulated carrier for mark, and to shift it 170 Hz lower for space, by 'pulling' the frequency of the transmitter's oscillator. This usually means building a special transmitter for RTTY, or modifying an existing one.

The other method, most commonly used these days, is to modulate an SSB transmitter with two audio tones spaced 170 Hz apart. If all stages in the transmitter are linear, a single tone of 2295 Hz at its input will result in a single carrier at its output, 2295 Hz above the 'suppressed carrier' RF frequency (this assumes upper sideband operation). A tone of 2125 Hz, 170 Hz lower, shifts the output frequency 170 Hz lower.

Any SSB transmitter can be used although it must be remembered that it's being made to supply power continuously, rather than intermittently as is the case with voice modulation. As most amateur SSB transmitters are rated for voice operation only, the output power must be kept well down for RTTY operation to avoid overheating in the final stage.

The author uses an elderly valve transceiver rated at 200 watts PEP input, but it's run at about 15 watts output on RTTY to avoid showing signs of strain. But, those 15 watts have brought good signal reports from all over the world.

Modulator

The tone generator has three output level controls to allow the tones to be simultaneously fed to the mic inputs of two different transmitters and a cassette recorder. It can be built in two versions, phase coherent and non-phase coherent.

The oscillator, a twin-T type, is set up to run on 2125 Hz, extra resistance being switched in to shift the frequency to 2295 Hz. This will happen any time the input logic signal changes from space to mark, even if the oscillator is only part way through a cycle. However, if the waveform changes in mid-cycle it's no longer a pure sine wave (it's distorted), and, if fed into an SSB transmitter, the distorted part of the sine wave would result in spurious outputs.

This problem can be solved by using the phase coherent option, where oscillator switching is not allowed until a full cycle has beeen completed. In other words, each burst of mark or space tone consists of a full number of cycles.

Many popular phase coherent designs generate the tones as square waves under the control of logic circuitry. The audio square waves are then pushed through filters in an attempt to clean them up into sine waves. To really filter them properly a complex filter is required.

We've tackled the problem in a completely different way. The tones are generated as sine waves. For phase coherent switching the tones are sampled, squared, and then the square waves are fed to the logic circuitry, which prevents switching until the sine wave sample indicates a cycle has finished. The result... low distortion, and no filtering required. The logic also allows mark high/mark low selection.

If you feel the phase coherent option is not worthwhile, the whole section can be left off the board, and the teletype signals can be fed straight into the oscillator switching transistor, at point A. In this case delete R1-R5, C1, Q1, IC1, and IC2.

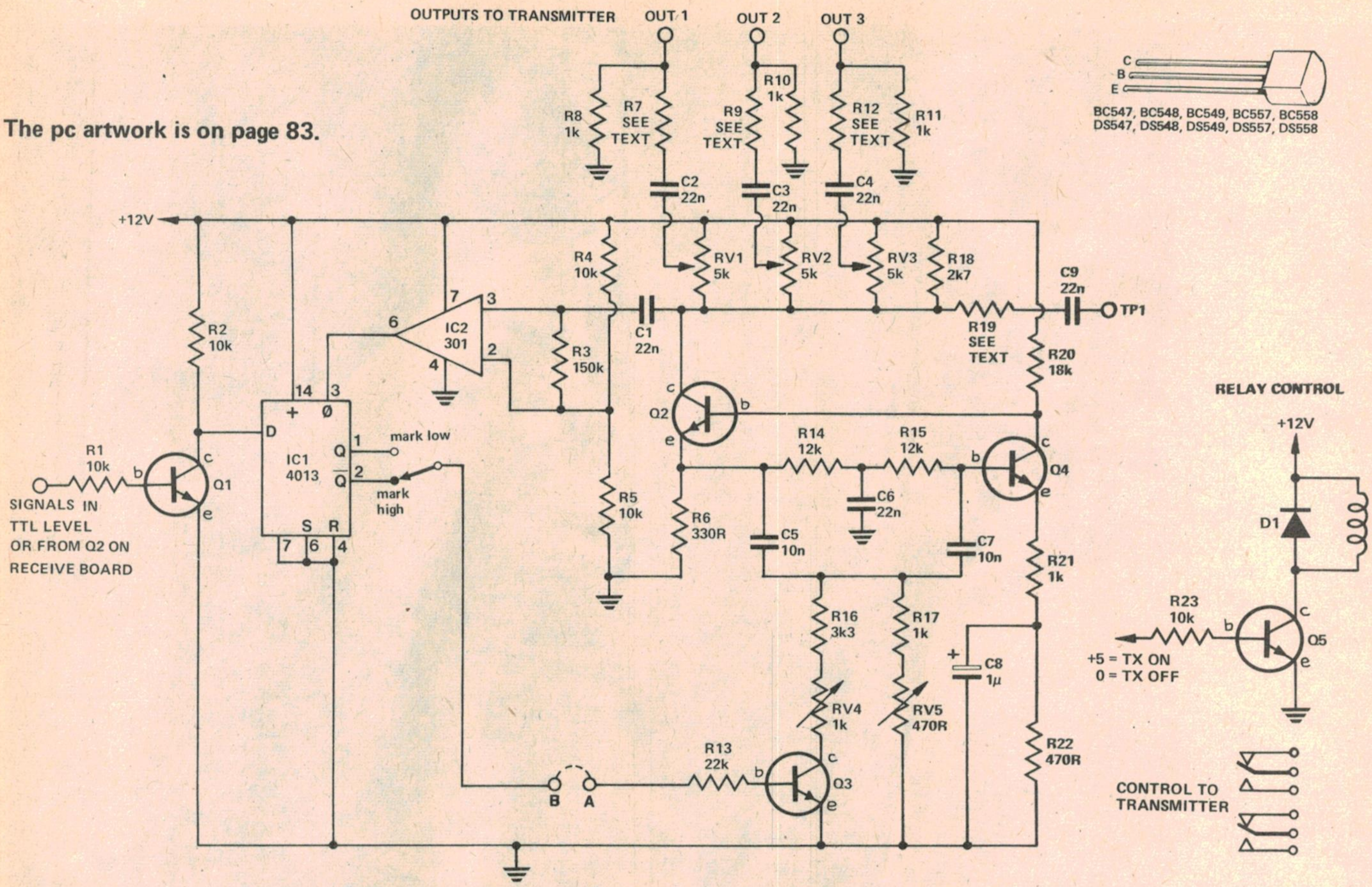
RADIOTELETYPE is a form of telegraphic communications employing typewriter-like machines (called teleprinters) for generating a coded set of electrical pulses when a key on the machine's keyboard is pressed, there being a unique code for each character. The same machine is also used to convert such coded pulses into the corresponding printed characters. A message is sent by typing it out on the keyboard, the printing being done at the remote, receiving, machine. The sending teleprinter may also print the same material.

Teleprinters were originally made for interconnection over telephone lines, operating on a subscriber system, similar to telephones. This sort of operation is increasing with modern machines.

A teleprinter may be connected to operate a transmitter and to print from a received signal — hence, radioteletype (RTTY). That is what this short series of articles is all about. Last month, Tom Moffat described the receiving converter — we have one installed with a receiver in the office and are having great fun with an old model 15 Teletype.

The picture here (ah yes . . . the picture) shows one facet of RTTY — 'teletype art'. Amongst the usual Santa Clauses, comic strip characters etc, are more elaborate efforts such as the Mona Lisa shown here coming off the printer. Most lines are overprinted two or three times and the picture takes 32 minutes sent at the 45.45 baud rate. This represents nearly 12 000 characters.

The pc artwork is on page 83.



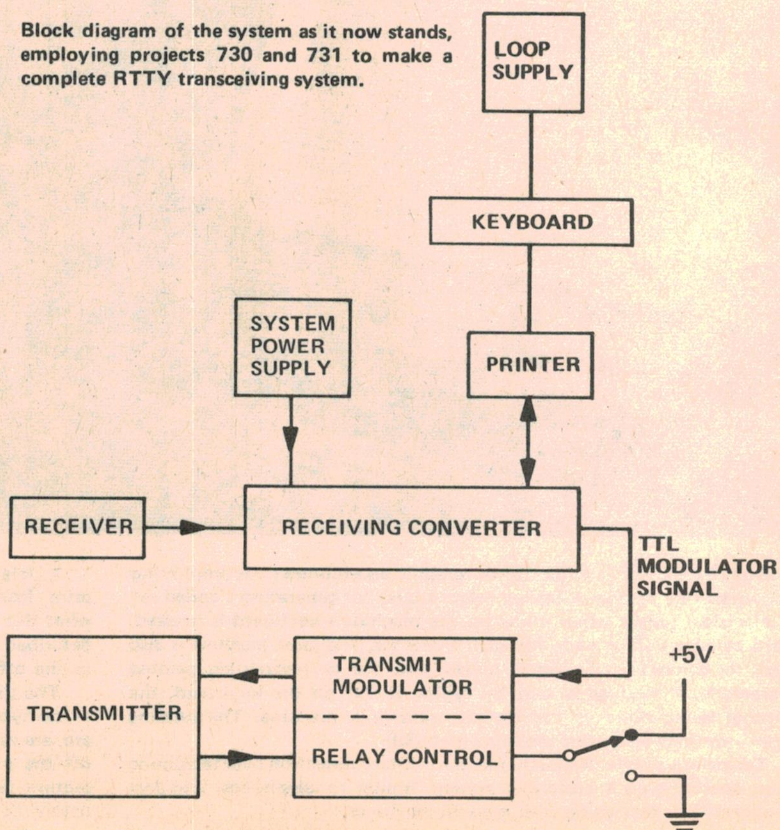
HOW IT WORKS

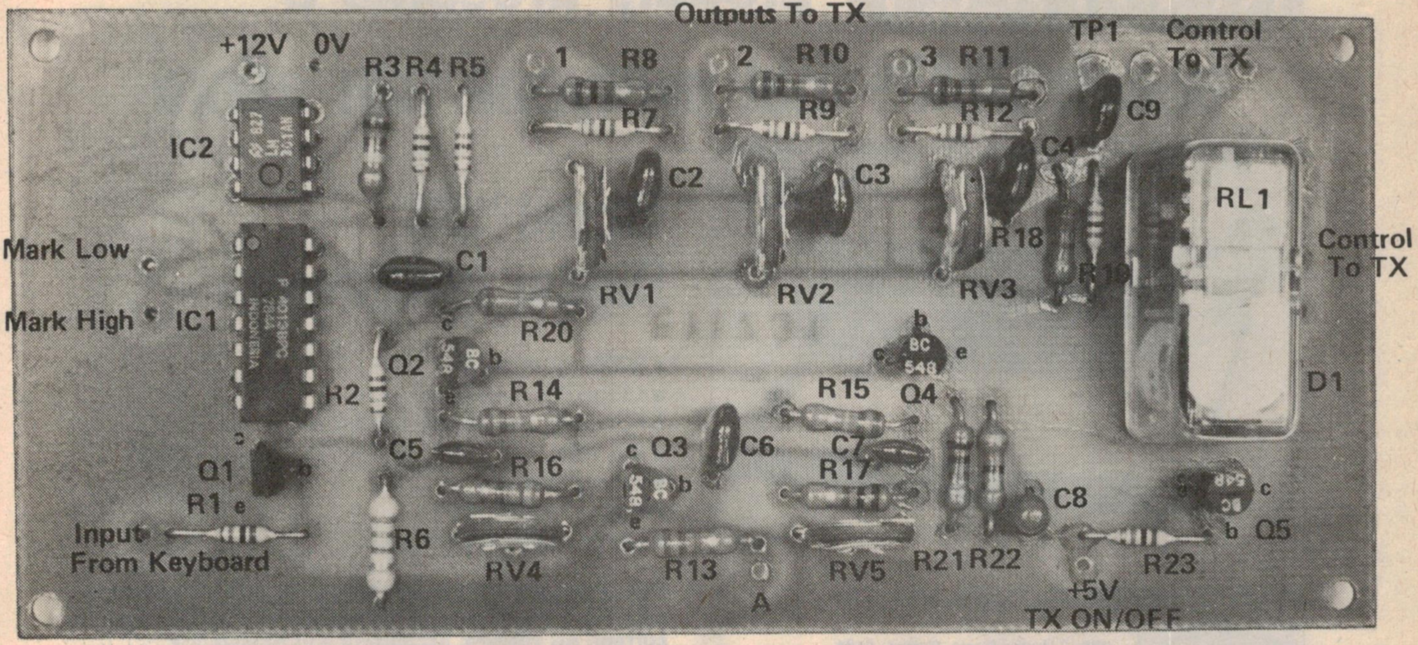
Transistors Q2, Q4 and associated components form a twin-T sine wave oscillator, with fine frequency adjustment provided by RV5.

When the base of Q3 is high it pulls the collector low, adding extra resistance (RV4 and R16) across RV5 and R17. This slightly raises the oscillator frequency. RV1, RV2, RV3 and R18 in parallel form Q2's collector resistor, from which the three outputs are taken. For phase coherent operation, another output is taken from Q2's collector via C1 and fed to op amp IC2, which is run 'flat out' forming a limiting amplifier. Its output is a square wave of about 10 volts peak to peak, which becomes the clock frequency for the flip-flop IC1.

Teletype data is fed via inverter transistor Q1 into the data input of IC1. The data appears at Q (mark low) or at $\overline{Q}$ (mark high) and is then fed into the oscillator switch at point A. Q and $\overline{Q}$ cannot change state to follow the input until IC1 receives a positive going clock pulse, which only occurs at the start of each oscillator cycle. So the oscillator can't 'switch' except at the start of a cycle, preserving phase coherence.

Block diagram of the system as it now stands, employing projects 730 and 731 to make a complete RTTY transceiving system.





Our overlay diagram for this project is something of an experiment. Reader comments are invited.

Construction

There is nothing in particular to watch out for here, except the CMOS IC (IC1). Keep it in its foil or conductive foam until ready for insertion, then solder the power pins 7 and 14 first. Install the rest of the parts in the usual way with the exception of R14, R16, R17 and R18, the values for which will be selected during alignment.

Alignment

For best accuracy a frequency counter is required. If you don't have access to one the receiving converter can be used to set the oscillator frequencies. In this case adjust the receiver to an off air signal known to have 170 Hz shift, and then connect it to the output of the oscillator. Use a CRO or VTVM to monitor the filter outputs while adjusting the tone frequencies.

Begin with the low tone, selected by earthing the logic input (if the phase coherent option is used be sure it's switched to 'mark high').

Adjust RV5 for 2125 Hz on the frequency counter (or maximum on the receiving converter space filter). Connect the logic input to +5 volts and the modulator frequency should shift higher. Adjust RV4 until the counter reads 2295 Hz (or maximum on the converter mark filter). Go between mark and space a couple of times as there is slight interaction.

Resistors R16, R17 and R18 are selected to provide the desired output levels to the transmitters and cassette recorder. To set them up, connect an output to a transmitter's microphone input, and then select the resistor to provide the desired power output. RV1, RV2 and RV3 can then be used for fine adjustment. TP1 can be connected back to the receiver demodulator to check the modulator output during transmit.

If an oscilloscope is not available R14 should be left out.

The modulator accepts logic-level signals and can be run directly from a TTL-output baudot keyboard or, by tapping a signal from the emitter of Q2 on the receiver decoder board (730), can be driven from the keyboard of the older-style teleprinter machines. The block diagram opposite shows the transceiver system.

(to be continued).

RADIOTELETYPE GROUP

The Australian National Amateur Radio Teletype Society (ANARTS) caters to persons interested in this mode of communications. Formed about two years ago, the Society has around 500 members throughout Australia. Based in Sydney, the group may be contacted through Peter Mulligan at 52 Houghton St, Yagoona 2199 NSW; phone (02) 709-6060 after hours or (02) 519-5855 during business hours.

The group can supply information on teleprinter machines, where they may be obtained, how to service them etc, as well as supply a number of kits for radioteletype applications — including the projects in this series of articles.

PARTS LIST - ETI 731

Resistors	all ½ Watt, 5%
R1, R2	10k
R3	150k
R4, R5	10k
R6	330R
R7	See text
R8	1k
R9	See text
R10, R11	1k
R12	See text
R13	22k
R14, R15	12k
R16	3k3
R17	1k
R18	2k7
R19	See text
R20	18k
R21	1k
R22	470R
R23	10k
Potentiometers	
RV1–RV3	5k miniature trim pot
RV4	1k miniature trim pot
RV5	470R miniature trim pot
Capacitors	
C1–C4	22n greencap
C5	10n greencap
C6	22n greencap
C7	10n greencap
C8	1µ 16V electro
C9	22n greencap
Semiconductors	
D1	IN914
Q1–Q5	BC548, BC108, DS548
IC1	4013
IC2	301

Miscellaneous
ETI 731 pc board, pc mounting change-over relay Pye Type 265/12/G2V or sim.

Errata
In last month's parts list, RV2 and RV3 were shown as 500 k - this should be 500R — the overlay and circuit are correct.

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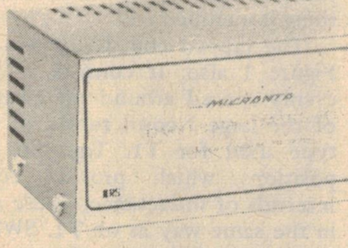

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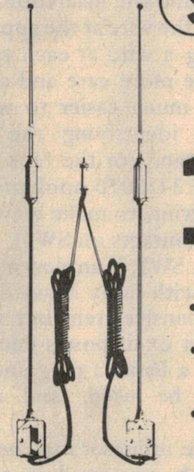

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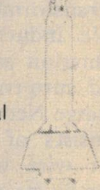

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Roger Harrison VK2ZTB

This unit will match a wide range of resistive and reactive impedances, commonly encountered with short or loaded antennas widely used in this frequency range, matching to 50 or 75 ohms. Locally available components are specified.

ANTENNAS for frequencies between 1.5 MHz and 7 MHz are usually limited in size by the amount of real estate available. Full sized quarter-wave verticals are difficult to achieve so one usually arrives at some sort of compromise. This often takes the form of a random length of wire, as long as possible and strung as high as possible. Loaded verticals are also used.

The feedpoint impedance of such compromise antennas is often lower than the 50 or 75 ohms at the transceiver antenna terminal, and is very often reactive – usually capacitive, particularly if the antenna is 'short' at the working frequency.

Most mobile antennas for these frequencies, particularly 'helical' wound whips, exhibit similar characteristics.

A good solution is to use a tapped auto-transformer in conjunction with a variable inductor. The circuit of this combination as shown in Figure 1. The tapped auto-transformer, T1, is wound on a large Neosid toroid (432/3/F14A). It consists of 32 turns of enamelled copper wire wound twice around the core as illustrated. The first 11 turns are wound with 14 or 16 gauge (swg) wire spread about two-thirds of the way around the core. The following 21 turns are wound with a lighter gauge wire such as 18 of 20 gauge. The taps are placed at intervals which give convenient impedance transformations.

Taps can be made in one of two ways. Where the wire for the appropriate turn passes across the outer face of the toroid, it can be lifted slightly when it is wound on. The insulation is then scraped off each tap after completing the whole winding and a wire soldered on to the tapping point, taking care not to cause shorts to adjacent turns.

Alternatively, the whole winding may be completed and the insulation scraped off portion of the wire at the appropriate turn, attaching a wire at each tap. This requires a little more care and skill, but the toroid is much easier to wind. Be careful when identifying the correct turn for each tap. For the taps at turns 7, 9 and 11 use 24/0076 hookup wire, or something heavier, to make connections to the switch contacts on SW1.

The switch, SW1, is an eleven position rotary switch with fairly heavy contacts. This is an expensive item but is sometimes found in ex-disposals equipment. Alternatively, a banana plug and eleven sockets may be used, and is quite economical.

The variable inductor may be a roller inductor which was used in a similar tuner described by Rod Champness VK3UG in the May 1976 issue of the Radio Bulletin. These devices are as scarce as hen's teeth these days but can occasionally be scrounged from ex-disposals gear – some people may have them in their junk box.

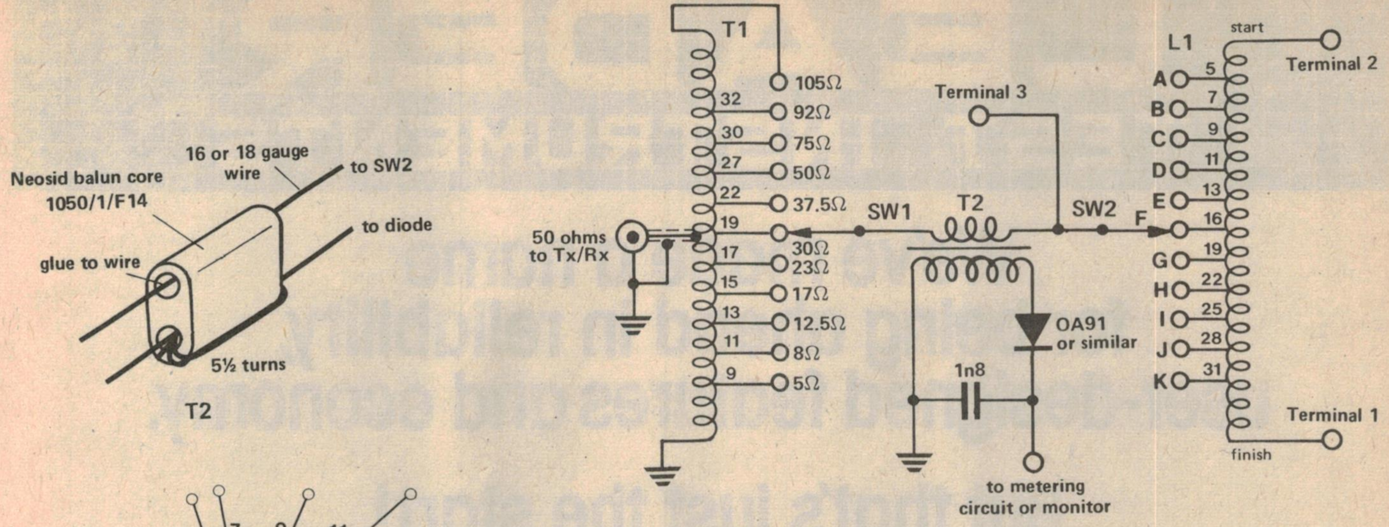
A commercially-manufactured version of this circuit uses a permeability-tuned coil. A length of ferrite rod is manually moved in or out of a coil to vary the inductance. Both of these variable inductors are elegant solutions in that they provide an infinitely-variable inductance, but both are difficult to physically realise if you are forced to construct them yourself. The next-best thing is a tapped coil.

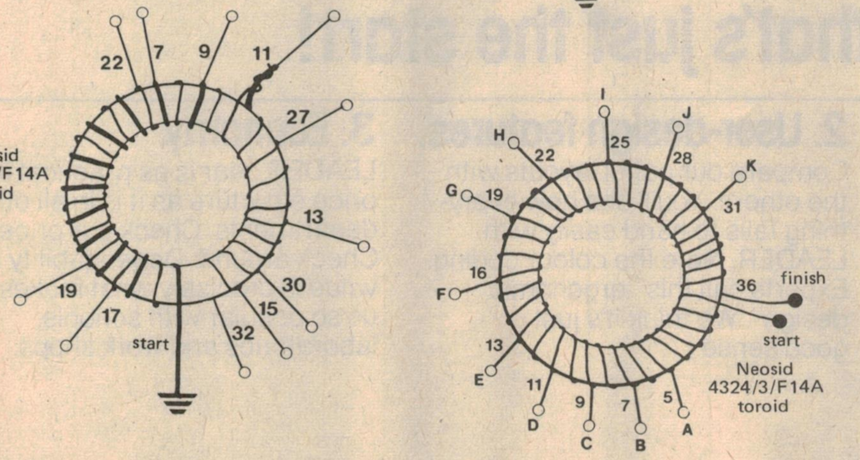
The tapped coil, L1, is illustrated in Figure 1 also. It consists of 36 turns evenly spaced around the cirumference of the large Neosid toroid of the same type used for T1. Taps are made at positions which provide convenient intervals of inductance. These are made in the same way as on T1. SW2 may be an eleven-position switch as for SW1 or a banana plug and sockets as suggested previously.

The antenna is connected between either of terminals 1, 2 or 3, and ground. If connected to terminal 1, SW2 provides relatively small increments of inductance, the percentage change increasing as tap K is approached.

If the antenna exhibits a large resistive impedance at the feedpoint, it can be connected between terminal 3 and ground.

The transformer T2 is used as a current transformer to provide a convenient signal for a metering or monitoring circuit. The wire connecting SW1 and SW2





COMPONENTS

The 4324/3/F14A toroid (two needed) and the 1050/1/F14 balun core are available from Neosid Pty Ltd, 23-25 Percival St, Lilyfield NSW and from Watkin Wynne Pty Ltd, 32 Falcon St, Crows Nest 2065 NSW.

All other components are generally available.

T1

Neosid ferrite toroid, type 4324/3/F14A (38.1 mm o.d. by 25.4 mm i.d. by 12.7 mm high, F14A ferrite material)

Total of 32 turns of wire wound twice around the core. Use 14 or 16 swg enamelled wire for the first 11 turns and 18 or 20 guage for the following 21 turns; taps as indicated.

L1

Neosid ferrite toroid as for T1.

Wind 36 turns of 28 swg enamelled wire around core, leaving an 8 mm gap between start and finish; taps as indicated.

Figure 1. **Circuit diagram and winding details for the coil and transformers. Note that a variable capacitor may be connected between terminal 3 and ground to change the circuit to an L-match type rather than simple coil loading. The 11-position switches must have contacts rated to stand the RF current for the power level used.**

is passed through one hole of a dual-hole balun, a Neosid type 1050/1/F14, which is glued in place. This forms the primary of the transformer. The secondary consists of 5½ turns of a light gauge enamelled copper wire or hookup wire wound through the other hole as illustrated in Figure 1. One end goes to ground, the other end goes to the diode rectifier circuit. The metering circuit may simply be a preset potentiometer in series with a suitable meter. Appropriate components are best determined by trial and error to suit the particular situation and power level of an installation.

In practice, SW1 and SW2 are adjusted for maximum antenna current as indicated by the metering circuit on T2. Alternatively, if an SWR meter is inserted in the transmission line between the transceiver and the tuner, adjust SW1 and for the lowest SWR or least reflected power. Do not operate SW1 and SW2 while power is applied.

The line to the transceiver from T1 is shown connected to the 50 ohm tap (22nd turn) in Figure 1. If a 75 ohm system is used, this may be connected to the 27th turn.

T1 works well between 1.5 MHz and about 7 MHz for all the impedance taps for 105 ohms down to 17 ohms. The lowest three taps only provide reasonable impedance transformations between 1.5 MHz and 3 MHz.

The tuner is suitable for use at power ratings up to 500W CW or PEP, providing sufficient care is taken with insulation, particularly with points that may carry reasonably high voltages. ●

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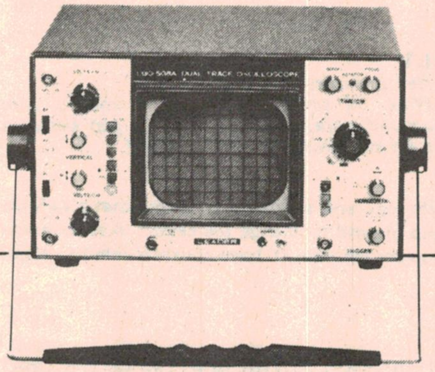

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Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here. Also, for a list of suppliers who stock the ETI projects published over the last 2½ years, our "Kits for Projects" page may always be found on the page immediately before the DREGS page (inside the back cover).

Printed circuit boards

Printed circuit boards for *every* project *ever* published in ETI are available from:

RCS Radio
651 Forest Rd
Bexley, 2007 NSW

Radio Despatch Service
869 George St
Sydney 2000 NSW

We have arranged to supply firms handling our projects with pc boards and front panel artwork in advance of publication commencing with the August 1979 issue. To date, the following firms have subscribed to this scheme and will have boards available for current projects before, or very soon after, publication of each issue:

Applied Technology, Sydney
James Photronics, Adelaide
Jemal Products, Perth
Mini Tech, Auckland N.Z.
RCS Radio, Sydney
Rod Irving Electronics, Melbourne

The following firms stock pc boards for a variety of ETI projects, past and present:

All Electronic Components, Melb.
Rod Irving Electronics, Melb.
Tasman Electronics, Melb.
Willis Trading, Perth
Dick Smith Electronics, all over

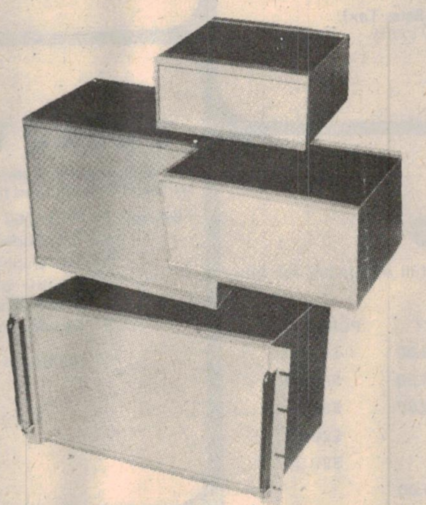
Strobe

Most kit suppliers have indicated that they will be stocking complete kits for this project.

For the resourceful constructor not starting from scratch, the strobe tube (type MFT1210) and trigger transformer (type TR4KN) are available from Circuit Components in Sydney and All Electronic Components in Melbourne. Dick Smith stocks a suitable strobe tube (Cat. No. S-3882) and trigger transformer (M-0104) also.

The RIFA, type PHN, 6 uF capacitors are rated for 240 Vac operation and are commonly used in fluorescent light installations. They are available from electrical wholesalers such as George Brown and Martin de Launay in Sydney (take packed lunch!). They are also available from All Electronic Components in Melbourne and Dick Smith Stores.

Various reflectors can be used, they are a common photographic item, but the kit suppliers will have them specially-made to suit the project.



Instrument cases

If you like to impart that 'professional look' to your projects then you'd almost certainly be interested in the range of instrument cases being marketed by Melbourne firm, Adaptive Electronics.

Simple to assemble, versatile, smart looking and very competitively priced, there are a range of sizes in stand-alone or rack mount models. Each case is supplied in knocked-down form and consists of :—

(a) Satin anodised 1.6 mm aluminium front and back panel, with surface suitable for screen printing etc.
(b) Top and bottom panels of hard wearing black "Marviplate" with a 1.0 mm steel base.
(c) Side panels of satin anodised 3.00 mm aluminium (m series) and 13 mm timber (w series).
(d) Four specially designed aluminium extrusions are used to hold the top, bottom, front and back panels in position. Provision is also available on the extrusion for mounting a metal chassis, circuit boards or edge connectors.
(e) Only eight screws are necessary four through each end plate to complete the assembly.

Options available are:

(1) The front and rear panels can be replaced with 3.0 mm satin anodised aluminium.
(2) The bottom panel can be replaced with 3.0 mm satin anodised aluminium.
(3) Side panels can be of the rack mounting type, handles also provided.

The popular models are the W502 (wooden ends) and M502 (metal ends), the first measuring 144 mm high by 438 mm wide by 290 mm deep; the second being 134 mm high by 419 mm wide by 280 mm deep — the rack mount option being most popular.

In fact, our very popular Series 4000 stereo amp was housed in an Adaptive Electronics model M702 case with the rack-mount end plates.

If you're interested, we suggest you call or write for a brochure; Adaptive Electronics, 77 Beach Rd, Sandringham 3191 Vic, (03) 598-4422. The cases should be available shortly through a number of suppliers in other states.

Series 4000 stereo amp.

So far as we can ascertain at time of going to press, the following companies are stocking *complete* kits of the Series 4000 Stereo Amplifier project, including cabinets, front panels and all modules.

Applied Technology, Sydney
Electronic Agencies, Sydney

The individual modules are available separately or as kits from the following suppliers (apart from the above two):

All Electronic Components, Melb.
DR Hi-Fi and Electronics, Sydney
Ellisttronics, Melbourne
Jaycar, Sydney
Mode Electronics, Sydney
Pre-Pak, Sydney
Radio Despatch, Sydney
Rod Irving Electronics, Melbourne
Silicon Valley, Sydney, Melb., Bris., Adelaide & N.Z.
Tasman Electronics, Melbourne

Scotchcal panels

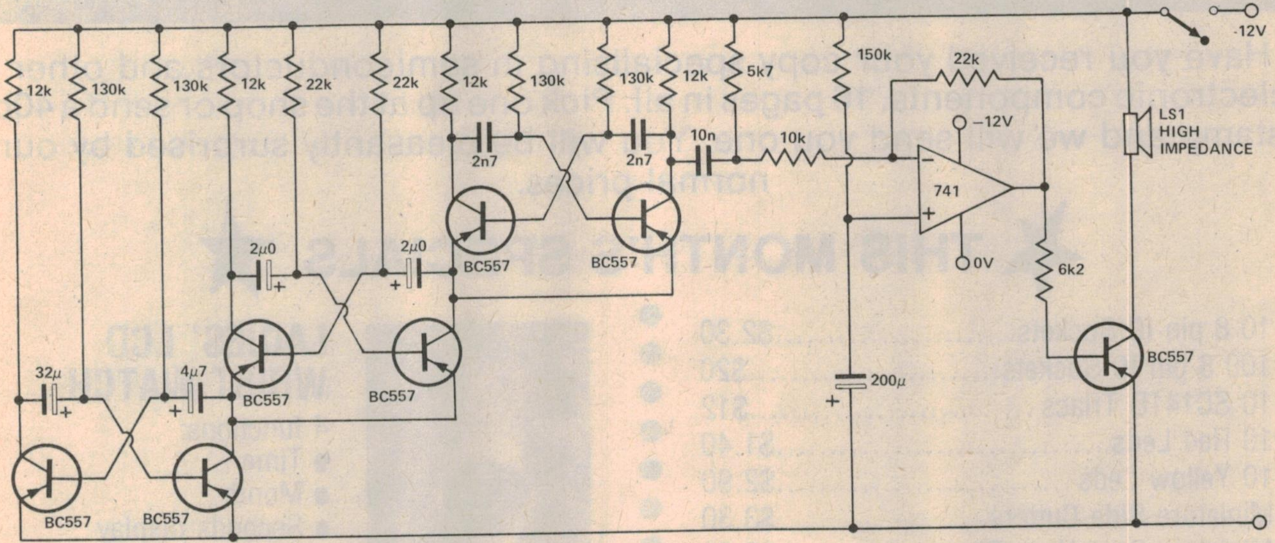
Radio Despatch Service in Sydney have advised that they will be able to provide Scotchcal front panels and meter scales for ETI projects in red, blue or black on silver background.

All new projects, and a number of past ones, which use Scotchcal front panels will be stocked.

Radio Despatch Service are located at 869 George St, Sydney; (02) 211-0816.

Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



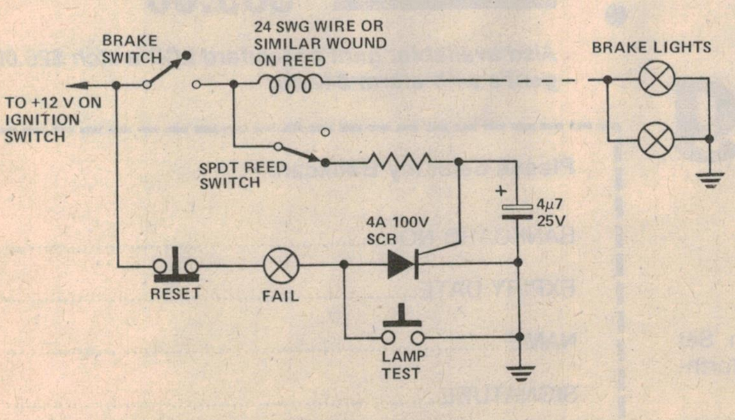
Gentle clock alarm

RING! RING! BUZZ! CLANG! PIP PIP!

This is hardly the sound that anyone wants to hear first thing in the morning (especially one of *those* mornings!)

There are gentler ways to wake up. This circuit provides an alarm which builds up from being inaudible to fairly loud over the course of about a minute. As a result, you are always woken up by the minimum volume required to wake you: a far more comfortable experience than the usual trauma!

The three multivibrators are connected so that the first two modulate the power supply of the third. The resultant signal is a rather pleasant warbling sound. This is shifted in dc level by the voltage at the non-inverting input of the op amp, and since this voltage is provided by R and C, it will rise slowly, shifting the signal in dc level and thus increasing the dc bias of the transistor. Thus the output of the circuit will rise slowly in volume.



Car lamp failure warning

Many lamp failure warning circuits indicate only when the lamp being monitored is supposed to be on. This circuit will 'latch' to show that the brake lights are faulty — even if the fault is intermittent, as is often the case with wiring faults.

Enamelled copper wire is wound onto an SPDT reed switch until a certain number of turns is found (by experiment) that will open the contacts when both lamps are working. If either of the lamps should fail, the contacts will remain closed, triggering the thyristor.

Rod Irving's 1979 Electronics Catalogue

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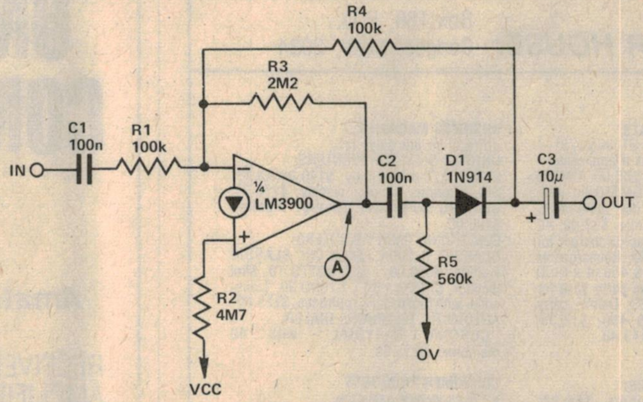
Ideas for Experimenters

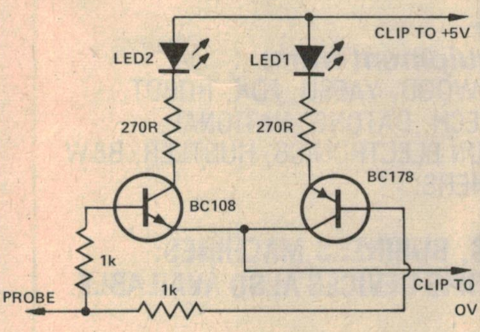
Precision rectifier



The LM3900 is different from most op-amps in that it is current-differencing and operates from a single supply rail. Standard precision rectifier circuits are not applicable for this device but the circuit shown here works well.

Two feedback paths are provided — R3 for dc stability and R4 for the ac signal after C2 and R5 have filtered out the dc bias. When R2 = 2 x R3, point A will be at half the supply voltage, allowing the diode to be reversed by the input signal.

For large positive input, input impedance equals R1 and voltage gain is — R4/R1, since R4 is made much smaller than R3. C1 and C3 are dc blocking capacitors and determine the low-frequency roll-off.



Simple logic probe

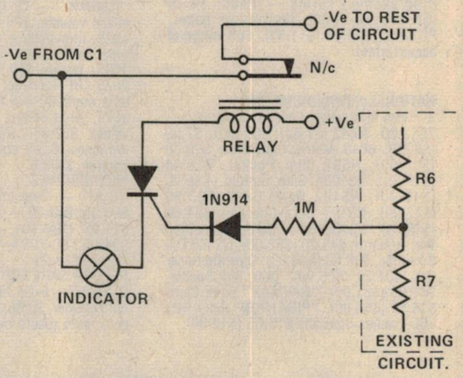
This probe is so simple in its operation that it needs almost no explanation. None of the components are at all critical. The circuit may be of use in designing a larger unit, with perhaps one of these probes for each of the pins of an IC clip.

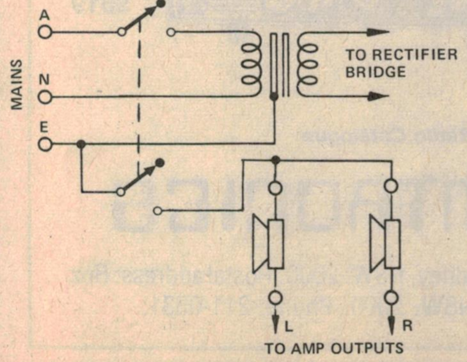
It might be a good idea to make the LEDs different colours, so that the state of the circuit under test can be seen at a glance. The NPN transistor (the left-hand one) will turn on the left-hand LED if the voltage on the test probe is high (nearer the + supply rail). The other LED will come on if the probe voltage is near zero.

Short circuit protection for ETI 132

John Peschar of Marks Point found that the overload indicator of his ETI 132 power supply gave insufficient warning. He developed this circuit which cuts the output of the supply when the current drawn reaches approximately 1.3A, latches and turns on an indicator to show that an overload condition has occurred.

The SCR used in his device was a C106D1, which had sufficient current capability to drive the indicator he used. D1 can be almost any silicon diode. It prevents feedback from the SCR gate to the rest of the circuit.





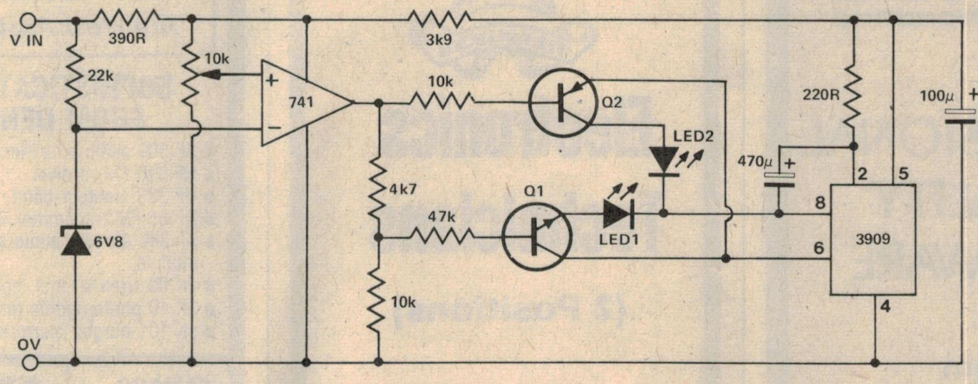
Pop killer

After building a small 12 W/channel amplifier, **Brian Modra** of Elizabeth Vale set about developing a means of stopping it from making annoying pops and bangs as it was switched off.

This little circuit uses only a double-pole switch (which must be capable of handling mains) which cuts off the speakers at the same time as the power is switched off.

Unfortunately, this circuit is not suitable for use with bridged amplifiers, but a little thought and a three pole switch should sort things out.

Ideas for Experimenters



Voltage level indicator

This circuit, by Fred Zickar of Bellambi, indicates the state of nickel-cadmium batteries in portable equipment.

LED 2 indicates a low battery voltage and the 3909 IC will make it flash when this occurs. The 3k9 resistor in the 3909 supply line varies the brightness of the LEDs. You can change it to suit ambient lighting conditions. The potentiometer sets the required 'battery OK' voltage. The circuit draws less than 10 mA.

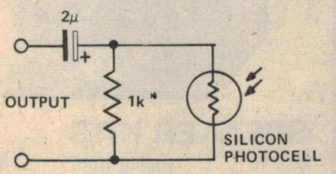
TV opto-isolator

The problem of how to connect a TV's sound to an amplifier or tape recorder is basically one of safety — TV sets use very high voltage. One approach is to pick up the IF from the set, but this requires that you strap a coil onto the back.

One way of getting an audio signal out without the risk of high voltage outside the set is to use an opto-isolator. This uses circuitry which converts the audio into a changing light level, and then detects this modulated light using another stage — electrically isolated from the first.

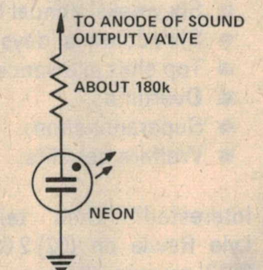
Two types of light modulator are shown here — the one with the neon attaches to the anode of the sound output valve and the other attaches to the loudspeaker terminals of the set.

The photocell has to be very close to the light producing part of the circuitry (it's a good idea to tape the cell to the neon or LED — but be careful that you preserve the electrical isolation) and shielded from outside light sources. The output of the detector is probably best fed to the most sensitive amplifier input you have, as the amplitude will be small.

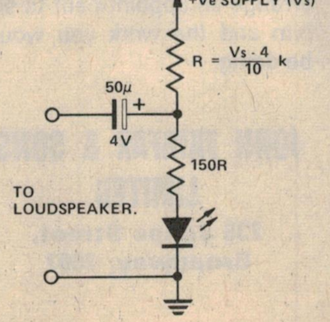


* ADJUST FOR MINIMUM DISTORTION

TRANSMITTER 1



TRANSMITTER 2



Mods to Project 148, versatile logic probe

Melbourne reader Les Fitch phoned to tell us that buffered type CMOS chips 4049s or even 4009s could be used in this project, but to get correct operation over the range of supply voltages from 5 V to 15 V, resistors R2 and R3 should be changed to a value of 1M each.

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

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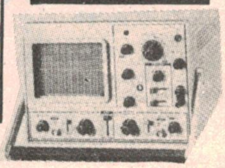

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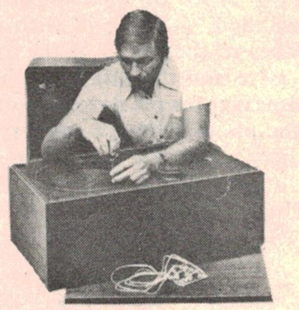

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Multimeter/calculator is a powerful tool

The Calcumeter 4100 reviewed

Les Bell

ONE OF THE major conceptual difficulties people experience in electronics is that only very rarely can one measure a quantity of interest, for example the gain of an amplifier. Often, one has to measure something (or several things) else, and then perform some calculation to finally arrive at the quantity required.

For example, current — it's often too much trouble to break the circuit, insert an ammeter or multimeter and then restore the circuit. Instead, one measures the voltage across a known resistance in the circuit, and then uses Ohm's Law to calculate the current.

Surely, you say, in this sophisticated, microcomputerized world something can be done to make life a little easier. You're right — and a company called Electro Scientific Industries has done it.

The Calcumeter 4100 combines a 3½ digit multimeter with a microprocessor-based calculator and controller, so that measurements can be made and calculations performed on them immediately, even automatically. A sophisticated selection of special measurement modes allows automated calculation such as scaling or removal of offsets, or even the graphic display of a value between preset limits!

Multimeter functions

The multimeter measures both dc and ac voltage and current as well as resistance, and is autoranging on all functions. The specifications are pretty standard for a meter of this type, except for the provision of a 19.99 mV scale — unusual for a meter with these capabilities.

What makes the Calcumeter unusual is its internal organization and the way it operates. It uses a custom CMOS microprocessor instead of a dedicated chip as in other meters.

Because of this, the Calcumeter offers some options in the way it operates. For example, two keys offer either the capabilitiy of making a single measurement and holding the result in the display — a must for computational procedures — or making continuously updated measurements. In addition, the range is set through the keyboard; for example, on dc volts, range 5 measures up to 199.9 V (all these ranges are indicated on the back of the instrument), while range 0 is auto-ranging for all measurement modes.

As a calculator

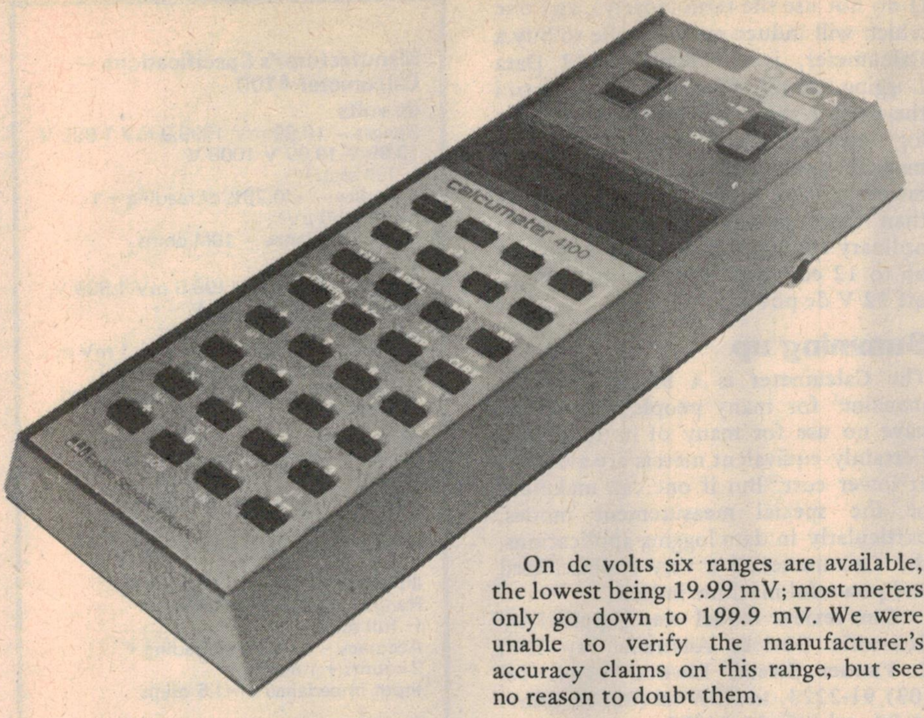
The Calcumeter operates in Reverse Polish Notation (RPN) and is rather reminiscent of a Hewlett Packard calculator.

It has one memory register plus a four-level operational stack, and features all the usual arithmetic functions plus logs to base e and base 10, exponentiation and power raising, and a 2π key — a novel touch and quite useful.

The display can be controlled in much the same way as an HP calculator and can be set to FIX and ENG display modes.

Calculation is performed to an internal accuracy of eight digits, although all measurements are only accurate to 3½ digits, a point which must be borne in mind when calculating on measurements. All eight digits can be displayed by pressing the DSP key twice; releasing it returns the display to its normal five digit mantissa plus two exponent form.

The keyboard is quite clear and uncluttered. Some nice touches have been added to the calculator: for example, when the M+ or other memory math key is pressed, the display shows the updated value of the memory contents. When it is released, the display returns to the X register.



The multimeter circuitry of the Calcumeter is quite comprehensive and offers measurement of current and voltage, both ac and dc, as well as resistance measurements. Range selection can be either manual (through the keyboard) or autoranging, although autoranging performance is usually preferred, both for ease of use and selection of best resolution.

The display formatting of the calculator also applies in the measurement modes, so that the display will indicate millivolts, (for example) by setting the exponent field to -03, if in the engineering display mode.

Two methods of measurement control are available; the HOLD key initiates a single measurement and returns the result in the x register (display). The CONT key allows continuous measurement, however power consumption is heavier in this mode and it is not recommended for battery use.

We found this to be a little awkward to use, with one hand for each probe, as we needed a third hand to operate the HOLD button. However, a little practice soon helped and using the crocodile clip on the earth probe frees one hand. The retention of the reading in the display is a definite advantage, though a switch on one of the probes would be a better way to initiate the measurement.

As a check on calibration, the Calcumeter was compared with our Fluke 8600 4½ digit DMM in the lab. Both instruments agreed closely on all functions, so it seems the Calcumeter meets the manufacturer's specification.

On dc volts six ranges are available, the lowest being 19.99 mV; most meters only go down to 199.9 mV. We were unable to verify the manufacturer's accuracy claims on this range, but see no reason to doubt them.

Special functions

Most of the functions examined thus far are standard on most calculators or multimeters, but the Calcumeter also includes several functions designed to enhance its unique 'dual personality'.

For example, a common problem faced by engineers is that of working out the value of two resistances in parallel. The Calcumeter offers a special mathematical function, xy/(x+y), which performs this calculation with just one keystroke. In addition, the function xy/(x-y), also provided, will calculate the value of resistor required to go in parallel with another to make up a specified resistance value.

Most calculations involving reactances and tuned circuits involve the term 2π, and so this key is provided rather than π alone.

As well as keys which perform functions in the calculator mode, some keys operate directly on measured values before the result is returned to the display. A common calculation is scaling and offsetting a measurement, such as to convert the output from a thermistor into a temperature value. This calculation always takes the form 7 = mx + b. This may be performed on each measurement as it is made.

To do this, the multiplying factor m is stored in the memory and the offset is stored in the y register of the stack. The mode key (shift) mx + b is then depressed, and the measurement is made using the HOLD key. The result appearing on the display is automatically scaled and offset, and can even be in degrees F and C, whichever you prefer!

Of course, the same function will also operate in the CONT mod of operation, enabling rapid set-up of a temperature control circuit, for example. (A temperature probe is available as an optional extra for the Calcumeter).

Another neat trick is the automatic averaging of measurements. To take, say, ten measurements and average them one simply stores 10 in the memory, presses (shift) AVG, and then the HOLD key. This initiates the series of ten measurements. After each, the Calcumeter displays the updated average in the display. Finally, the meter stops, with the result in the display. A very useful feature indeed.

Pressing the CONT key in this mode will make the device display a continuously updated average until HOLD is depressed.

Conversion of voltage measurements to dB relative to another reference value is tedious if many measurements are to be made. Once again, Calcumeter to the rescue! If the reference value is stored in the memory, then the (shift) dBV keys depressed, any subsequent voltage measurements will be expressed in dB relative to the pre-stored value.

For percentage deviation calculations, again, the same function is supplied. Labour saving, indeed.

An application which sometimes arises in industry is the sorting of resistors by value within certain limits. Guess what! Yes, this intrepid machine will even perform this function automatically, giving the display in the form of a bar graph. Say you wish to sort 1 k resistors into eight groups between 950 and 1050 ohms. The limits are stored in the memory and y registers, and the (shift) LIMITS keys depressed. When a measurement is made, the display will now divide into eight equal areas divided by seven dots, and a bar will illuminate in the appropriate area. Pressing the DSP key will reveal the measured value of the resistor, returning the graph into the display when released.

Subsequent measurements will operate in the same way, until the (shift) NORMAL key returns the meter to normal operation (this also holds for the other special measurement modes). If the resistor value falls below the lower limit, the meter will display *-Error*, if it is above the upper limit it will display *Error*.

The (shift) INV key will automatically calculate the inverse of any measurement and may be used, for example, to calculate conductance instead of resistance.

The meter includes a beeper which audibly informs the operator of an error. It may be disabled if not required.

The Calcumeter comes packaged in a solid case clearly designed to protect

against mechanical shocks. This case also accepts the standard accessories (two probes with leads, crocodile clips, direct application probe, and spare probe). The manual is first class, in a style similar to HP's calculator manuals, with plenty of examples and clear, concise explanations illustrated diagramatically where necessary.

One thing we aren't keen on in the operation of the meter is that on initial power-up, the display contains random garbage and the keyboard is inoperative – the machine has to be manually reset. Why some form of power-on reset circuitry wasn't included is a question for the designers. It is only a minor inconvenience, but one feels it shouldn't be there.

Optional extras

Several extras are available to increase the versatility of the Model 4100. For a start there's the usual things, like a battery eliminator, an adaptor plug to accept banana plugs, a soft pouch, RF probe, current shunt, clamp-on current probe and standard probe set. Then there are the accessories which are unique to the Calcumeter: a foot switch to augment the HOLD key, a temperature probe and a serial ASCII interface.

Perhaps the most powerful peripheral (I do not use the term loosely), and one which will induce many people to buy a Calcumeter, is the Model 4142 Data Logging Printer. Under external control the printer/meter combination will data log measurements continuously, on manual command, or at preselected intervals from three seconds to more than three hours. The printout is on ordinary adding machine tape, in formats up to 12 columns wide, and may be run off 12 V dc power.

Summing up

The Calcumeter is a bit of a 'dream machine' for many people who would have no use for many of its functions. Certainly equivalent meters are available at lower cost. But if one can make use of the special measurement modes, particularly in data logging applications, the Calcumeter is a very sophisticated and powerful machine indeed.

Our review model was supplied by Scientific Devices Australia Pty Ltd, 2 Vautier Street, Elwood 3184. Tel (03) 91-2223. In NSW tel (02) 76-8069. In SA, tel (08) 25-56575.

At the time of going to press, the price of the Calcumeter and its accessories were (excluding sales tax): Calcumeter, $408.00; Battery eliminator, $15.00; Data logging printer, $332.00; Temperature probe, $80.00.

Manufacturer's Specifications – Calcumeter 4100

dc volts
Ranges – 19.99 mV 1999.9 mV 1.999 V 19.99 V 19.99 V 1000 V
(± full scale)
Accuracy – ±(0.25% of reading + 1 count + 50 μV)
Input impedance – 10M ohms

ac volts
Ranges – 19.99 mV 199.9 mV 1.999 V 19.99 V 1999.9 V 750 V
(± full scale)
Accuracy – ±(1% + 2 counts + 1 mV at 400 Hz, >1% harmonic distortion)
Input impedance – 10M ohms shunted with <50 pF

dc current
Ranges – 1999 mA 1999.9 mA
(± full scale)
Accuracy – ±(0.35% of reading + 1 count + 50 μA)
Input impedance – ≈1.6 ohms

ac current
Ranges – 19.99 mA 199.9 mA
(± full scale)
Accuracy – ±(1.2% of reading + 2 counts + 1 mA)
Input impedance – ≈1.6 ohms

Resistance
Ranges – 199.9Ω 1.999 kΩ 19.99 kΩ 199.9 kΩ 1.999 MΩ 19.99 MΩ
Accuracy – ±(0.30% of reading + 1 count + 0.6 ohms)
Open circuit voltage – ±5 V

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100uF 50vw	.12	22uF 16vw	.08
220uF 25vw	.18	100uF 16vw	.10
470uF 50vw	.40	220uF 50vw	.20
1000uF 63vw	.70	330uF 10vw	.10
2500uF 16vw	.60	470uF 50vw	.50

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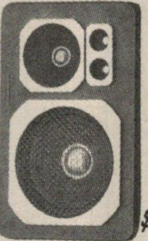

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2 Watt - 5, 10, 250, 500, 2K, 5K $1 ea. 5 Watt - 10, 100, 250, 500, 2.5K, 5K, 10K, 25K, 50K, 100K, 250K $2 ea.

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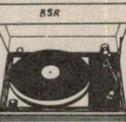

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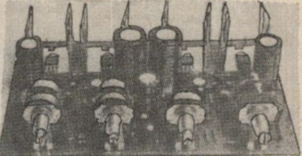
20W STEREO AMP



Reviewed in ELECT. AUST. August p.127

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eti data sheet

The RPY86 is an infrared sensitive device, combined with a pre-amplifier which is stabilised to overcome dc drift due to temperature changes. It is hermetically sealed in a TO-5 package. Applications include intruder detection — it is sensitive to the band of infrared which the human body emits.

Operating notes

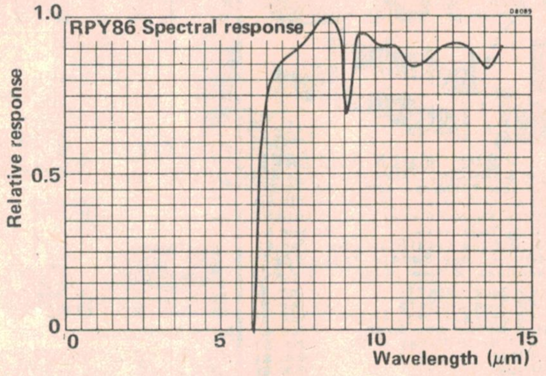
A thermal shunt must be used when soldering. It is essential that any mains-operated soldering irons be both screened and earthed. Alternatively, a socket could be used to hold the device.

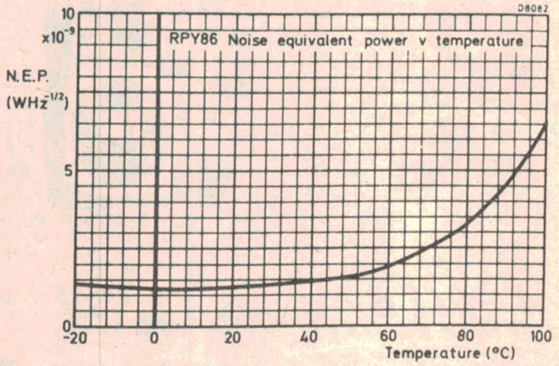
- The case potential of the device must not be allowed to become positive with respect to the other two terminals.
- The shape of the output waveform is the integral of the incident radiation waveform.
- It is inadvisable to operate the detector at any harmonic of the mains frequency.
- The detector must be firmly mounted to avoid microphony.
- An increase in the element temperature will produce a negative-going signal at the output.

Spectral response (see graph)	6.5 to 14	μm
Responsivity	640	volts per watt of incident light (both RMS)
Noise equivalent power	1.3×10^{-9}	$WHz^{-1/2}$ (see note below)
Field of view	145	degrees
Operating voltage	9 (Absolute max. 30)	V
Operating frequency	0.01 to 1000	Hz
Storage and operating temperature	−20 to 100	°C

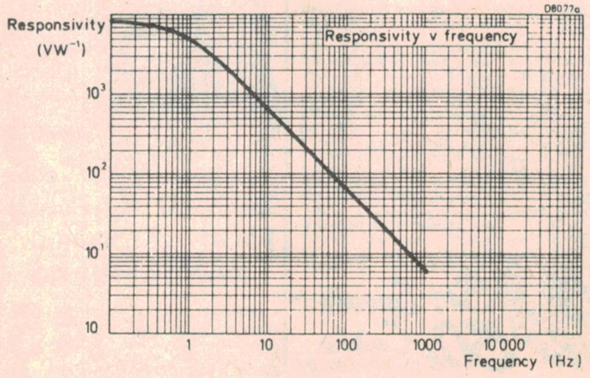
Note: Noise equivalent power is defined as the RMS value of the incident, chopped, radiant power necessary to produce an RMS signal to RMS noise ratio of one. The RMS noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$.

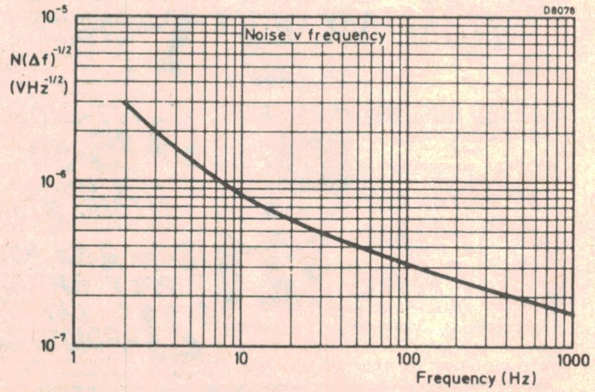
Further information on this device can be obtained from: Philips Industrial Holdings, Elcoma Division, 67 Mars Road, Lane Cove, NSW 2066. Ph (02) 427 0888.





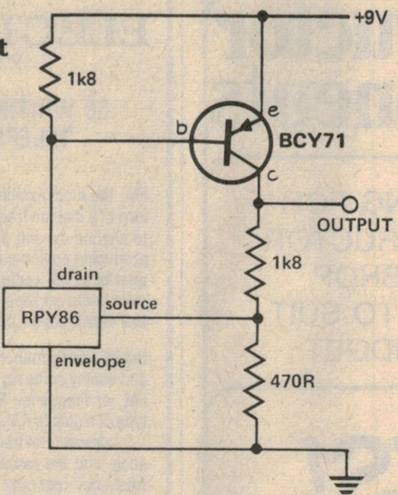
RPY86

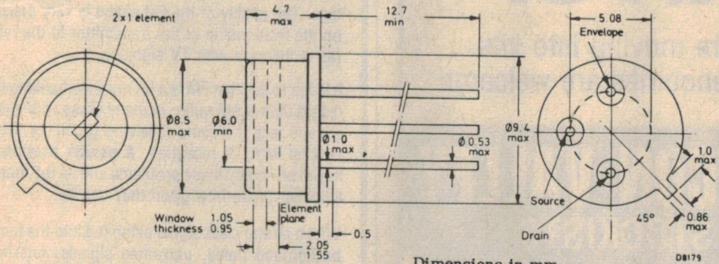




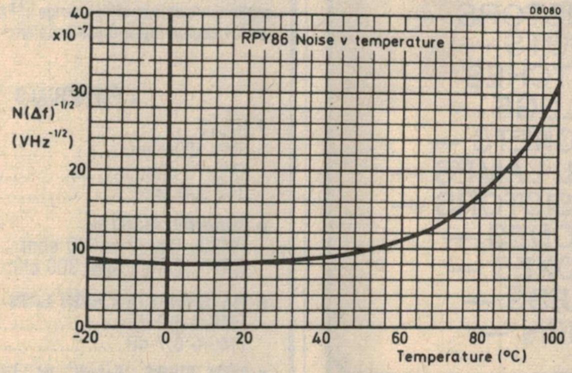
RPY86 infrared detector

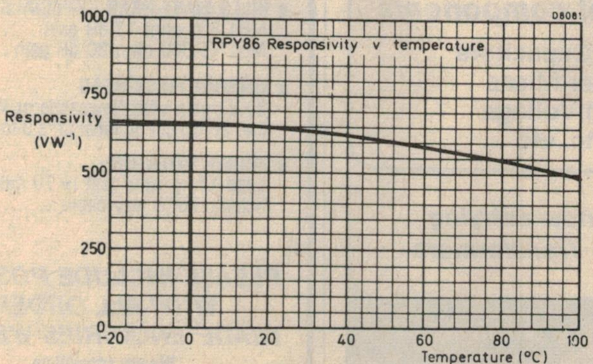
Test circuit





Dimensions in mm





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4006	1.35	4023	0.25	4053	1.00
4007	0.25	4024	0.90	4060	1.50
4008	1.20	4025	0.30	4066	0.75
4009	0.70	4027	0.70	4071	0.35
4010	0.70	4028	0.95	4072	0.35
4011	0.25	4029	1.20	4073	0.35
4012	0.25	4030	0.45	4075	0.35
4013	0.55	4035	1.50	4081	0.35
4014	1.20	4040	1.20	4082	0.35
4015	1.15	4042	1.10	4510	1.30
4016	0.50	4043	1.00	4511	1.30
4017	1.20	4044	1.00	4516	1.30
4018	1.20	4046	1.50	4518	1.30
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7400	0.20	7440	0.25	7495	0.90
7401	0.20	7442	0.65	7496	1.00
7402	0.20	7446	0.90	74100	1.50
7403	0.20	7447	0.90	74107	0.50
7404	0.25	7448	0.90	74109	0.55
7405	0.25	7450	0.25	74121	0.50
7406	0.40	7451	0.25	74122	0.60
7407	0.40	7453	0.25	74123	0.60
7408	0.25	7454	0.25	74125	0.70
7409	0.25	7460	0.25	74126	0.70
7410	0.20	7470	0.45	74132	1.00
7411	0.28	7472	0.45	74141	1.25
7412	0.28	7473	0.45	74145	1.10
7413	0.40	7474	0.45	74151	0.90
7414	0.60	7475	0.60	74153	0.90
7416	0.50	7476	0.40	74154	1.30
7417	0.50	7480	0.80	74157	0.85
7420	0.28	7482	1.00	74160	1.10
7421	0.30	7483	1.00	74164	1.30
7423	0.35	7485	1.30	74165	1.30
7425	0.35	7486	0.45	74174	1.30
7426	0.35	7489	2.00	74176	1.10
7427	0.35	7490	0.40	74177	1.10
7430	0.25	7491	0.90	74184	2.20
7432	0.35	7492	0.55	74185	2.20
7437	0.35	7493	0.40	74192	1.00
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555	$0.30	3909	$1.15
723	0.50	7805	0.90
741	0.35	2N3055	0.75
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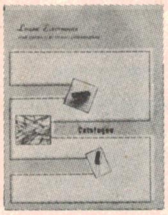
10-40pf Trimmer 30c
2200u/40V Axial Electrolytic 70c



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But this performance is largely dependent on the level and quality of the signal fed into the FM tuner because FM, or Frequency Modulation, is a totally different type of signal to AM. It has two important advantages . . . almost total freedom from atmospheric interference, and the capability of reproducing a far wider frequency response than is possible with AM. But with these advantages comes one minor disadvantage. The quality of the FM signal is very dependent on the relationship of the transmitter to the receiver (as is the case with TV signals).

It is fair to say that FM is a lot more demanding in this regard than is AM radio. In many cases your customers will face the same receiving problems they encounter with TV reception. **A quality antenna** will, however, rectify these problems and let the tuner and amplifier prove how good they can be.

With a strong clear signal being fed into the receiver, background noise, unwanted signals, interference and reflections are reduced to a minimum.

We at Electrocraft, knowing the problems of TV reception, are able to offer a range of FM antennas that can overcome these these problems

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  FM3 75 ohm $28.55
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  FM700 Fringe Area 300 ohm $19.68
- **MATCHMASTER HIGH GAIN**
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  Include: 70' 3 way cable $99.00

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30 years in the antenna business
Hours: 8am to 5pm. Sat 10am to 12 noon.

The exciting challenge of shortwave DX listening

Bob Padula

This is the concluding part of how to wet your feet in what some regard as 'the ultimate of hobbies'.

IN THE FIRST PART of this article, I covered the aims of the DXer, equipment and reception patterns and how to find marker stations. This month I have a list of the easy to find marker stations that prove useful in finding your way around a band and conclude with reception conditions on the lower frequencies, band charting, how to keep records and the sort of accessories you'll find handy.

Lower frequencies

So far we've confined our discussion to the higher frequency bands for general familiarity with daytime reception patterns.

Frequencies below 5950 kHz are normally used for regional or local broadcasting; it is these bands that offer the greatest interest and challenge to DXers, particularly for stations located in Latin America and Africa. At present these bands are organized as follows:

60 metres: 4750-5060 kHz;
90 metres: 3200-3400 kHz;
120 metres: 2300-2500 kHz;
75 metres: 3900-4000 kHz.

To gain experience with reception patterns within these bands, exactly the same procedure is followed as for the higher frequency bands.

Marker stations are sought which give reliable and steady signals at your location.

For example, in Melbourne a good marker station at night is the Venezuelan station at San Cristobal, using the slogan "Ecos del Torbes" operating on 4970 kHz. This comes on at 0900 GMT and often is the strongest signal in the band, broadcasting in Spanish. The time signal stations on 5000 kHz – WWV, WWVH and JJY, can also be used as marker stations.

The important thing to remember is that the low frequencies are heard best during the darkness hours, and the high frequencies generally come in well during the day. During years of high sunspot activity, such as at present, the high frequencies will be available for much longer times, often throughout the night. It is of no value tuning around the 90 metre band in the middle of the day and expecting to hear DX signals – they just won't be there!

Band charting

By now, you will have realized that it is impossible to remember the band conditions existing at a particular time, and the actual occupancy of the various frequency channels. Many DXers maintain what are called "band charts", which are simply ruled sheets, frequencies given down the page and times (in GMT) across the page. The various signals audible are then marked on these charts, perhaps in different colors to indicate the various continents. Corrections and amendments can be made easily, either by the use of small stick-on adhesive labels, or by rubbing out.

The scope for this sort of charting is virtually unlimited and can be as detailed as the DXer wishes. Without some form of charting, the DXer is, frankly, wasting his time as he has no real way of knowing the band or station conditions that exist at a particular hour. By keeping his band charts up to date, he is able to know instantly whether a particular frequency for a given station is in use (i.e: is audible). This form of charting is used by professional monitors around the world and has been proven to be the optimum

way of keeping track of frequency occupancy and usage by manual means. (Blank band charts, already ruled and printed, are available through the Australian Radio DX Club for members' use).

DX targets

Every DXer must have some sort of hobby objective! Over the years, I have seen many people come into the ranks of DX clubs – they flounder around aimlessly – tune in here and there and by chance come across something that interests them. They send off a report or two – get a few QSLs back, and are then never heard of again.

The DXer must be prepared to develop his own skills in identification of unknown stations, and this will come with experience. Similarly, the new DXer should not feel put off by his inability to grasp the elements of non-English languages; not many of the world's top DXers have had formal training in linguistics and their knowledge of languages and language patterns has been learned from their own hobby involvement.

For starters, I would suggest that the new DXer approach the hobby cautiously and not try and take too many big bites too soon! A good plan is to become involved with one international band, at whatever time is most convenient, but at the same time each day or night. Study the characteristics of this selected band – get to know the stronger stations and their propagation patterns – get this down on some form of band chart for future reference, and start off with the stations using English. The rest will follow!

Try and get QSLs from the English speaking stations first of all; practise the skills of reception report writing on these stations and at a later stage you can graduate into writing to stations for programmes in other than English.

Most DX clubs offer comprehensive material to new members on how to write reception reports. You may decide only to send reception reports to stations in a particular country or continent or you may choose to operate only within a particular band. Whatever you do, at least have something to aim for and move into it gradually.

Records

Unless you are prepared to keep accurate records of what you have reported and QSLed your hobby will mean very little.

Some sort of log book is essential for both "Reports Out" and "QSLs Received". An ordinary school exercise book is good enough for this and you rule the various columns yourself. The front of the book can be used for noting the details of reports sent out, in numerical order; the back of the book can be for recording details of QSLs received, in date and numerical order. Cross references between the two listings are essential.

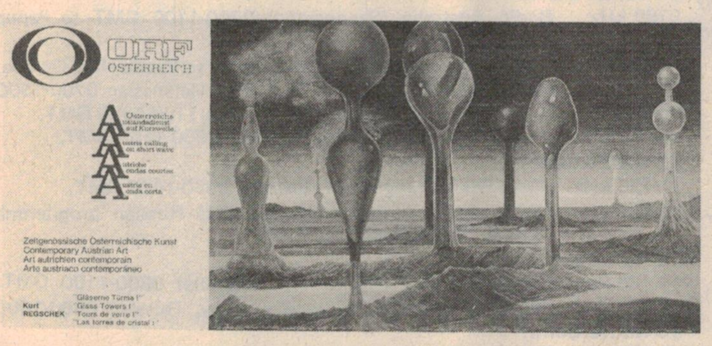
When you have started to build up a fair sized QSL collection some sort of alphabetical listing of Countries QSLed will be needed. This can be done using ordinary index cards, one for each country, and on each card you put details of the station, frequency, date reported, and date the QSL arrived. Thus, if you want to know the status of any given country (or frequency of the station there) you have instant access. The best way to file QSLs is in photo albums – the ones with clear plastic overlays over cardboard leaves. These are cheap and readily available at chain stores. Extra pages can be bought as required, or new albums introduced. QSLs can also be used to decorate the walls of your den, room, or whatever. It is important to know where any particular QSL is kept, for reference, and for display to visiting DXers.

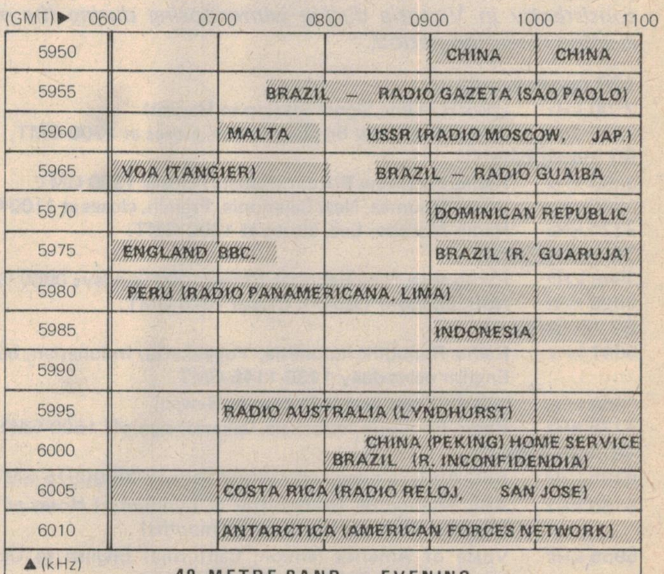
DXing aids

First of all, membership of a reputable DX club is essential. DX clubs offer a variety of special services and literature. The ARDXC has available a large range of special publications on various aspects of the hobby as do most clubs. DX club bulletins offer useful references of what is being heard, even if a little out of date by the time they are received. Membership also offers the facility of getting in touch with other people in your area having a similar interest. This makes the hobby so much more enjoyable, being able to exchange ideas and study QSLs and techniques.

DX clubs often maintain localized branches where members can meet regularly, usually at each other's homes, on an informal basis.

It is almost mandatory to have a copy of the current edition of the





49 METRE BAND – EVENING

Part of BANDCHART compiled by the author showing signals audible winter/spring between 0600–1100 GMT between 5950–6010 kHz.

"World Radio TV Handbook", published annually in Denmark. The 1979 edition runs to well over 500 pages and is available through DX clubs or commercial sources. It gives the most comprehensive information available on world broadcasting with schedules, personnel, QSL policies, and individual station addresses. It is regarded world wide as the DXer's "Bible". Supplements are published three times a year.

A tape recorder is also a handy thing to have around. It can be used to record programmes for subsequent playback to extract details for including in reception reports. This is particularly useful when preparing reports in languages other than English. Some DXers have modified their cassette machines to take continuous tapes, and in this way everything heard is recorded. This overcomes the problem of tape changing just at that critical moment when the station identification announcement is given!

Most DXers use at least one, often more, anciliary gadgets to improve their DXing. Probably the most important is a good pair of padded *earphones.* Stereo type phones are suitable, if modified.

Antenna tuning units are in demand, particularly when older receivers are used which have poor image rejection characteristics. Older receivers also benefit from *outboard preselectors* which give a decent lift to performance, particularly at the HF end of the tuning range.

Audio notch filters are now starting to become widely used, connected between receiver output and speaker or phones, and can be used to reduce or eliminate annoying audio heterodynes.

If you use more than one external antenna some sort of *antenna switching box* is necessary.

If you can afford it, some form of *frequency meter* is worthwhile if you use a set that is not gifted with direct frequency readout. I have used a DX-555 Counter-Generator for some time, which serves the purpose well. Some DXers use the *Number 10 Crystal Calibrator*, many of which have been released onto the surplus market in recent years. The *BC-221 Frequency Meter* (and its many variants) is in widespread use and can still be purchased new as well as secondhand.

There are many circuits available for small crystal markers, which provide outputs at selected spot frequencies; generally every 1, 5, 10, or 100 kHz.

Conclusion

In an article of this nature, it is not possible to cover every facet of the subject. I have tried to set down the main points which I believe will assist newcomers to the hobby. The material has been offered specifically for embryo DXers, but shortwave listeners may of course derive something from the topics covered. A lot of what has been said is based on many years hobby involvement; the author is also a professionally qualified communications engineer.

The essence behind this article is that DXing is a rather complex thing; it requires patience, dedication, and a systematic approach for full satisfaction to be derived. It can be pursued at any pace, dependent on the hobbyist's choice. It need not be expensive; reception reports can use up a fair proportion of hard won savings, but so does any hobby!

My advice to aspiring DXers: don't rush out and buy the most expensive and fancy receiver you can find – start off with something relatively simple and be prepared to develop your hobby skills and ability gradually. Choose some sort of hobby objective – join one or more of the reputable DX clubs and you will never regret it! ●

ADDITIONAL INFORMATION

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Membership particulars are available from:

Hon. Secretary, ARDXC,
Box 67, Highett, Victoria 3190

or from:

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Narrabeen, NSW 2101
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Please enclose a 30c stamp with enquiries and give a phone number for contact. Also, please mention "ETI".

"Marker stations"

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75 metre band:
3945 kHz Radio Vila, New Hebrides. Closes 1000 Sundays 0900 GMT).
3925 kHz NSB, Sapporo (Japan). Closes 1615 GMT.

60 metre band:
5047 kHz Radio Republik Indonesia, Yogyakarta, Indonesian, but has English news daily 1130-1145 GMT.
5000 kHz WWVH Time Signal Station at Hawaii.
4775 kHz Radio Republik Indonesia, Jakarta, sign-off 1600 GMT.

49 metre band:
6195 kHz BBC Antigua relay, with World Service 09000915 GMT.
6150 kHz ABC Melbourne (transmitter at Lyndhurst) closes at 1402 GMT (or 1303 during Summer months)
5955 kHz Voice of America (Dixon, California) English to Oceania opens at 1100 GMT to 1400 GMT close.

41 metre band:
7170 kHz Radio Noumea, New Caledonia. French, to close at 1100 GMT with "La Marsellaise".

31 metre band:
9760 kHz Radio Australia (Shepparton) 0700-1100 GMT to Papua New Guinea.
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15 130 kHz Radio Moscow, English (to Australia) 0800-1100 GMT.
15 410 kHz Voice of America, Philippines relay, Russian 0800-1600

16 metre band:
17 705 kHz BBC England, World Service 0900-1115 GMT.
17 875 kHz All India Radio, New Delhi, English 1000-1100 GMT.

13 metre band:
21 670 kHz American Forces Radio Service (Philippines relay) 0100-0900 GMT
21 465 kHz Radio Finland. English 0930-1000, Finnish 1000-1100 GMT.

11 metre band:
25 650 kHz BBC England, World Service 0900-1500 GMT.
27 790 kHz Radio RSA, the Voice of South Africa, English 1100-1200

***Note:** *the above list is representative only. Frequencies may be changed by the stations to avoid interference, but the outlets selected for this Survey are those that have been in use for long periods and the possibility of variation is small. Out of band operations have been omitted for the purpose of this List.*

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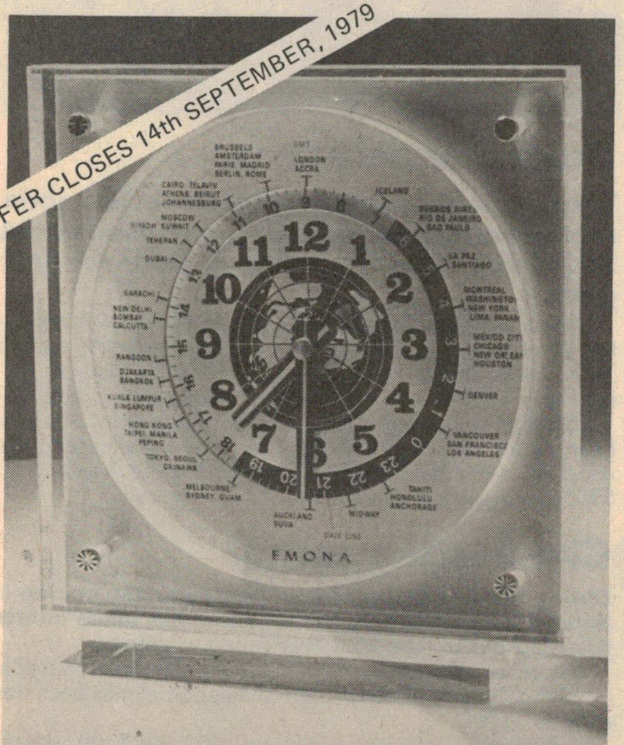

This sturdily-constructed clock is designed with the radio amateur and shortwave enthusiast in mind. It clearly shows the time in all of the World's major time zones. At a glance, you can see the time in GMT, without having the bother of subtracting or adding hours to the present time, or any other sort of calculation. The clock is powered from a single D cell and comes complete with a full year's guarantee.

The World Time Clock normally retails for $75. We have arranged for ETI readers **only** to receive this piece of equipment for just $49.50 (plus $2 postage and packing).

NOTE: This offer is made by Emona Enterprises and ETI is acting as a clearing house for orders only. Cheques should be made **payable to 'World Time Clock Offer'** and sent, together with the order form (or a photocopy of it) to **'World Time Clock Offer', ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011.** We will then process your order and send it on to Emona, who will send you the goods. Please allow **four weeks for delivery.** Offer closes **14th September** and is open to **Australian residents only.**

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I enclose a cheque/money order for $51.50, payable to 'World Time Clock Offer'.

Another great ETI offer

All eyes on Geneva Radio Conference

All DXers and shortwave listeners will be vitally interested in the deliberations of the World Administrative Radio Conference (WARC '79) which will begin in Geneva on the 24th of this month.

Convened by the International Telecommunications Union, WARC '79 is the first conference of its kind for 20 years, and will have the task of reviewing and recommending modifications to the frequency spectrum above 1605 kHz.

The conference is scheduled to last for 10 weeks, indicating the scope and complexity of the issues to be covered.

Communications authorities from over 140 countries will be attending, and WARC '79 will have as one of its major tasks the easing of the chronic overcrowding within the current high frequency broadcasting bands between 1.6 MHz and 30 MHz.

Since the last conference, in 1959, overcrowding of the HF bands has become so acute that currently, up to 20 percent of all HF broadcasts now take place **outside** the designated bands, usually on frequencies adjacent to these bands. A good example of this is just above the 25 metre band. In the range 11 975-12 100, many stations can be noted on any evening.

Broadcasting on out-of-band channels has now become a common practice, so much so that even stations with a reputation for conservative frequency selections, such as Austrian Radio and Radio Nederland, have moved out-of-band.

Many stations seem to be anticipating expansion of the HF broadcast bands by moving onto clear channels out-of-band. This practice means they will have "first claim" on these channels with the International Frequency Registration Board (a division of the ITU) which is responsible for international frequency co-ordination.

DXers world wide have been concerned that several European international broadcasters are recommending to WARC '79 that the 60 metre band (4750-5100 kHz), currently reserved for local broadcasting in tropical countries, be made available for short-distance international broadcasting within Europe. If accepted, this proposal would mean the international giants with their 250 and 500 kilowatt transmitters would ruin the 60 metre band for DXers seeking to hear the many low powered Asian, African and Latin American stations currently found on 60 metres.

However, the good news is that the countries of the developing world, biggest users of the 60 metre band, have resolved to oppose this move. For example, at a meeting of developing countries recently held in Yaounde (Cameroun) in preparation for WARC '79, all delegates resolved to firmly oppose any moves to open up the 60 metre band for international broadcasting.

The developing countries realise the importance of shortwave broadcasts for reaching remote rural areas of the territories at relatively low cost. With the developing countries having the numbers at Geneva this month, it is almost certain the 60 metre band will remain the preserve of local tropical broadcasters.

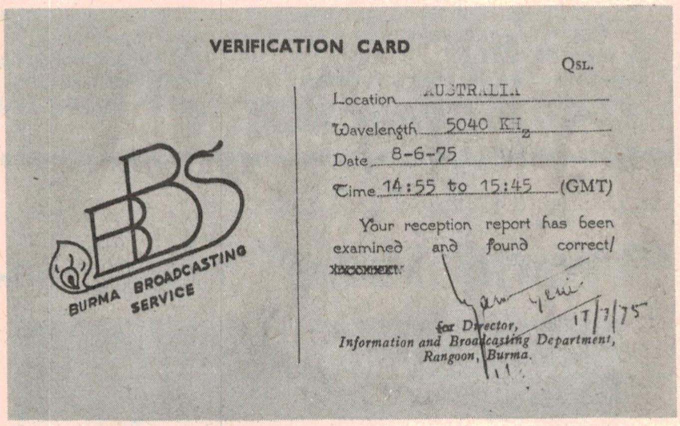
This does not rule out the possibility of certain "maverick" administrations going their own way. South Africa, for example, already makes use of the 60 metre band for international broadcasting, and will no doubt continue this practice, no matter what WARC '79 may recommend.

This also goes for any other decisions of WARC '79. Neither the ITU nor the International Frequency Registrations Board division have any powers to enforce the decisions reached. All countries will no doubt have to take a flexible stance at the conference, so that a compromise plan can be reached.

The responsibility for drafting Australia's proposals for the conference lies with the Federal Department of Post and Telecommunications. The department has drawn up these tentative proposals for WARC '79, for the high frequency broadcasting bands:

3950-4000 kHz (a reduction of 50 kHz for the present band)
4750-5060 kHz (no change to this band)
5950-6200 kHz (no change)
7100-7500 kHz (expansion of 200 kHz)
9350-9995 kHz (expansion of 370 kHz)
11 500-11 975 kHz (expansion of 200 kHz)
13 700-18 800 kHz **(proposed new broadcast band)**
15 100-15 760 kHz (expansion of 310 kHz)
17 600-17 900 kHz (expansion of 100 kHz)
21 450-21 870 kHz (expansion of 120 kHz)
25 760-26 100 kHz (reduction of 160 kHz)

Whatever the decisions made at the World Administrative Radio Conference during this month and October, these will not result in overnight changes to the HF broadcasting scene. It will be several years before any major changes can be considered by the individual governments and put into effect.



Burma re-activates

The Burma Broadcasting Service in Rangoon has recently re-activated its 60 metre band outlet, on 5040 kHz, for programmes in Burmese and English.

Burma's English service is on the air daily from 1430 until 1600, with the world news broadcast at 1445.

The English service may be heard at the same time on the usual 49 metre band outlet of 5985. Rangoon looks kindly on reception reports from listeners which are promptly answered if return postage is sent.

Reports should go to the Director General of the Information and Broadcasting Department, Prome Road, Kamayut P.O., Rangoon.

Clandestine corner

During the recent troubles in Nicaragua, the station of the Sandinista guerillas, Radio Sandino, has made interesting listening during the east Australian evenings.

Best reception has been on 7700, from sign-on at approximately 1150 most nights, although sign-on has sometimes been noted as early as 1100.

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The station has also been observed on 7588 in Melbourne, but signals are considerably weaker on this outlet.

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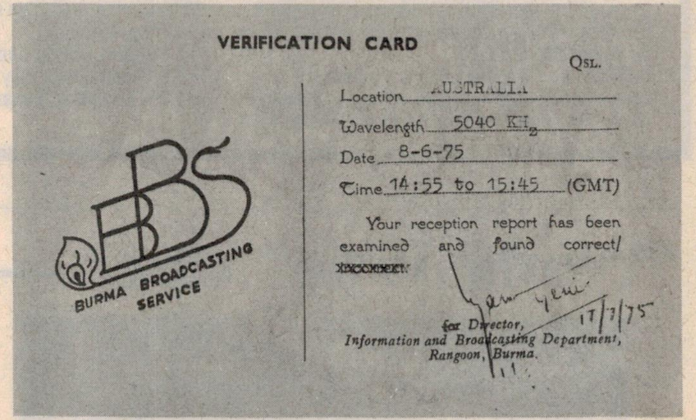

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17 705 kHz	BBC England, World Service 0900-1115 GMT.
17 875 kHz	All India Radio, New Delhi, English 1000-1100 GMT.

13 metre band:

21 670 kHz	American Forces Radio Service (Philippines relay) 0100-0900 GMT
21 465 kHz	Radio Finland. English 0930-1000, Finnish 1000-1100 GMT.

11 metre band:

25 650 kHz	BBC England, World Service 0900-1500 GMT.
27 790 kHz	Radio RSA, the Voice of South Africa, English 1100-1200

***Note:** *the above list is representative only. Frequencies may be changed by the stations to avoid interference, but the outlets selected for this Survey are those that have been in use for long periods and the possibility of variation is small. Out of band operations have been omitted for the purpose of this List.*

way of keeping track of frequency occupancy and usage by manual means. (Blank band charts, already ruled and printed, are available through the Australian Radio DX Club for members' use).

DX targets

Every DXer must have some sort of hobby objective! Over the years, I have seen many people come into the ranks of DX clubs – they flounder around aimlessly – tune in here and there and by chance come across something that interests them. They send off a report or two – get a few QSLs back, and are then never heard of again.

The DXer must be prepared to develop his own skills in identification of unknown stations, and this will come with experience. Similarly, the new DXer should not feel put off by his inability to grasp the elements of non-English languages; not many of the world's top DXers have had formal training in linguistics and their knowledge of languages and language patterns has been learned from their own hobby involvement.

For starters, I would suggest that the new DXer approach the hobby cautiously and not try and take too many big bites too soon! A good plan is to become involved with one international band, at whatever time is most convenient, but at the same time each day or night. Study the characteristics of this selected band – get to know the stronger stations and their propagation patterns – get this down on some form of band chart for future reference, and start off with the stations using English. The rest will follow!

Try and get QSLs from the English speaking stations first of all; practise the skills of reception report writing on these stations and at a later stage you can graduate into writing to stations for programmes in other than English.

Most DX clubs offer comprehensive material to new members on how to write reception reports. You may decide only to send reception reports to stations in a particular country or continent or you may choose to operate only within a particular band. Whatever you do, at least have something to aim for and move into it gradually.

Records

Unless you are prepared to keep accurate records of what you have reported and QSLed your hobby will mean very little.

Some sort of log book is essential for both "Reports Out" and "QSLs Received". An ordinary school exercise book is good enough for this and you rule the various columns yourself. The front of the book can be used for noting the details of reports sent out, in numerical order; the back of the book can be for recording details of QSLs received, in date and numerical order. Cross references between the two listings are essential.

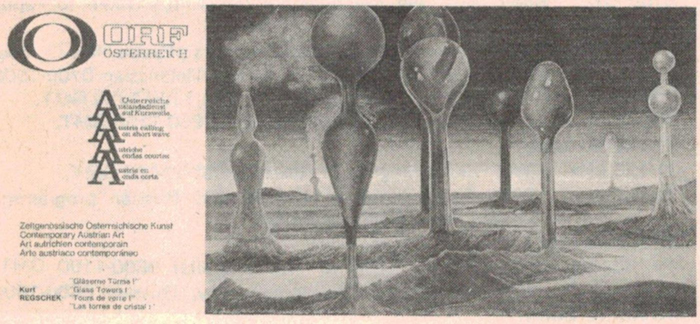
When you have started to build up a fair sized QSL collection some sort of alphabetical listing of Countries QSLed will be needed. This can be done using ordinary index cards, one for each country, and on each card you put details of the station, frequency, date reported, and date the QSL arrived. Thus, if you want to know the status of any given country (or frequency of the station there) you have instant access. The best way to file QSLs is in photo albums – the ones with clear plastic overlays over cardboard leaves. These are cheap and readily available at chain stores. Extra pages can be bought as required, or new albums introduced. QSLs can also be used to decorate the walls of your den, room, or whatever. It is important to know where any particular QSL is kept, for reference, and for display to visiting DXers.

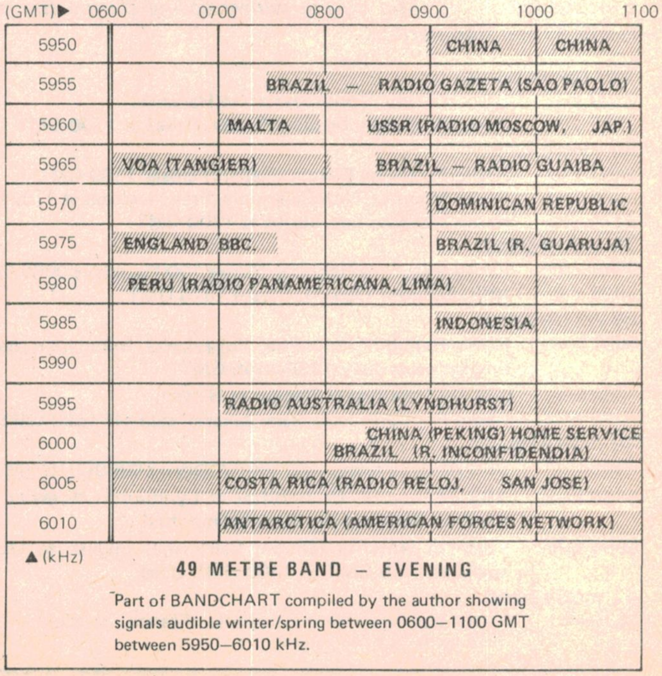
DXing aids

First of all, membership of a reputable DX club is essential. DX clubs offer a variety of special services and literature. The ARDXC has available a large range of special publications on various aspects of the hobby as do most clubs. DX club bulletins offer useful references of what is being heard, even if a little out of date by the time they are received. Membership also offers the facility of getting in touch with other people in your area having a similar interest. This makes the hobby so much more enjoyable, being able to exchange ideas and study QSLs and techniques.

DX clubs often maintain localized branches where members can meet regularly, usually at each other's homes, on an informal basis.

It is almost mandatory to have a copy of the current edition of the





49 METRE BAND – EVENING

Part of BANDCHART compiled by the author showing signals audible winter/spring between 0600–1100 GMT between 5950–6010 kHz.

The exciting challenge of shortwave DX listening

Bob Padula

This is the concluding part of how to wet your feet in what some regard as 'the ultimate of hobbies'.

IN THE FIRST PART of this article, I covered the aims of the DXer, equipment and reception patterns and how to find marker stations. This month I have a list of the easy to find marker stations that prove useful in finding your way around a band and conclude with reception conditions on the lower frequencies, band charting, how to keep records and the sort of accessories you'll find handy.

Lower frequencies

So far we've confined our discussion to the higher frequency bands for general familiarity with daytime reception patterns.

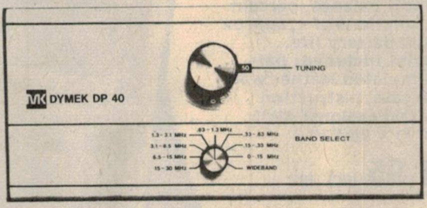
Frequencies below 5950 kHz are normally used for regional or local broadcasting; it is these bands that offer the greatest interest and challenge to DXers, particularly for stations located in Latin America and Africa. At present these bands are organized as follows:

60 metres: 4750-5060 kHz;
90 metres: 3200-3400 kHz;
120 metres: 2300-2500 kHz;
75 metres: 3900-4000 kHz.

To gain experience with reception patterns within these bands, exactly the same procedure is followed as for the higher frequency bands.

Marker stations are sought which give reliable and steady signals at your location.

For example, in Melbourne a good marker station at night is the Venezuelan station at San Cristobal, using the slogan "Ecos del Torbes" operating on 4970 kHz. This comes on at 0900 GMT and often is the strongest signal in the band, broadcasting in Spanish. The time signal stations on 5000 kHz – WWV, WWVH and JJY, can also be used as marker stations.



The important thing to remember is that the low frequencies are heard best during the darkness hours, and the high frequencies generally come in well during the day. During years of high sunspot activity, such as at present, the high frequencies will be available for much longer times, often throughout the night. It is of no value tuning around the 90 metre band in the middle of the day and expecting to hear DX signals – they just won't be there!

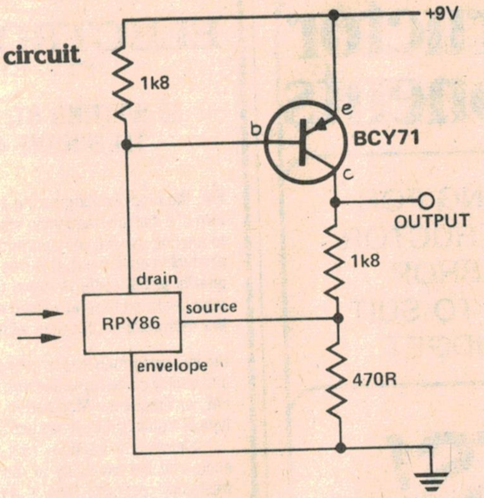
Band charting

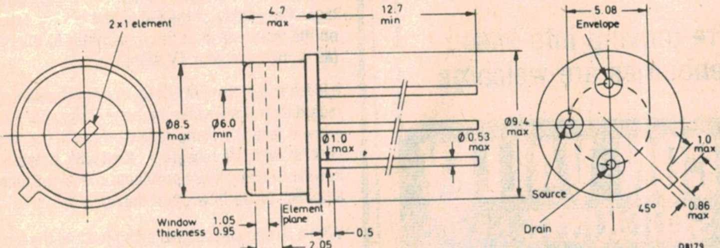
By now, you will have realized that it is impossible to remember the band conditions existing at a particular time, and the actual occupancy of the various frequency channels. Many DXers maintain what are called "band charts", which are simply ruled sheets, frequencies given down the page and times (in GMT) across the page. The various signals audible are then marked on these charts, perhaps in different colors to indicate the various continents. Corrections and amendments can be made easily, either by the use of small stick-on adhesive labels, or by rubbing out.

The scope for this sort of charting is virtually unlimited and can be as detailed as the DXer wishes. Without some form of charting, the DXer is, frankly, wasting his time as he has no real way of knowing the band or station conditions that exist at a particular hour. By keeping his band charts up to date, he is able to know instantly whether a particular frequency for a given station is in use (i.e: is audible). This form of charting is used by professional monitors around the world and has been proven to be the optimum

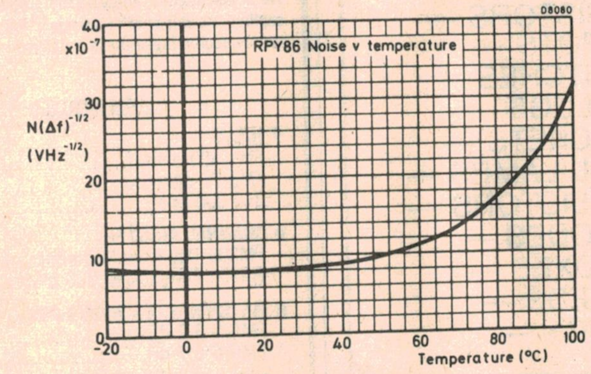
RPY86 infrared detector

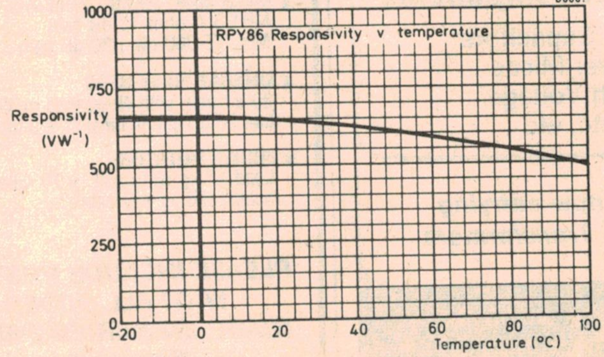
Test circuit





Dimensions in mm





eti data sheet

The RPY86 is an infrared sensitive device, combined with a pre-amplifier which is stabilised to overcome dc drift due to temperature changes. It is hermetically sealed in a TO-5 package. Applications include intruder detection — it is sensitive to the band of infrared which the human body emits.

Operating notes

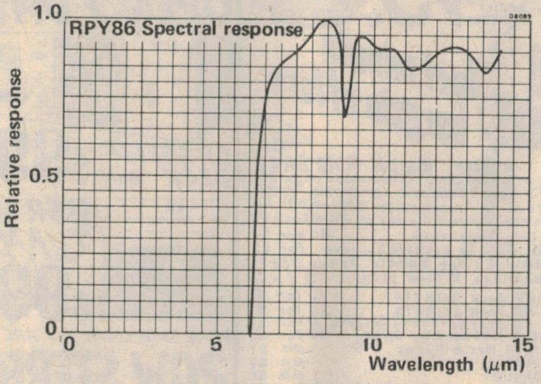
A thermal shunt must be used when soldering. It is essential that any mains-operated soldering irons be both screened and earthed. Alternatively, a socket could be used to hold the device.

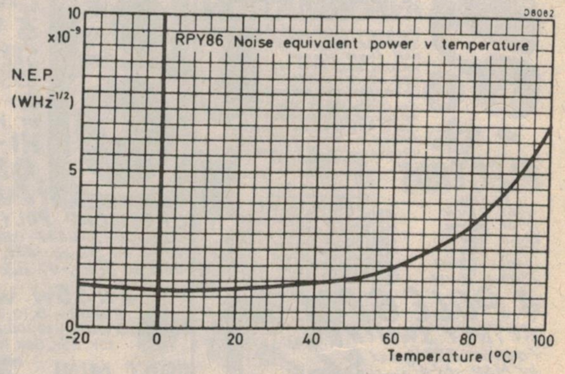
- The case potential of the device must not be allowed to become positive with respect to the other two terminals.
- The shape of the output waveform is the integral of the incident radiation waveform.
- It is inadvisable to operate the detector at any harmonic of the mains frequency.
- The detector must be firmly mounted to avoid microphony.
- An increase in the element temperature will produce a negative-going signal at the output.

Spectral response (see graph)	6.5 to 14	μm
Responsivity	640	volts per watt of incident light (both RMS)
Noise equivalent power	1.3×10^{-9}	$WHz^{-1/2}$ (see note below)
Field of view	145	degrees
Operating voltage	9 (Absolute max. 30)	V
Operating frequency	0.01 to 1000	Hz
Storage and operating temperature	−20 to 100	°C

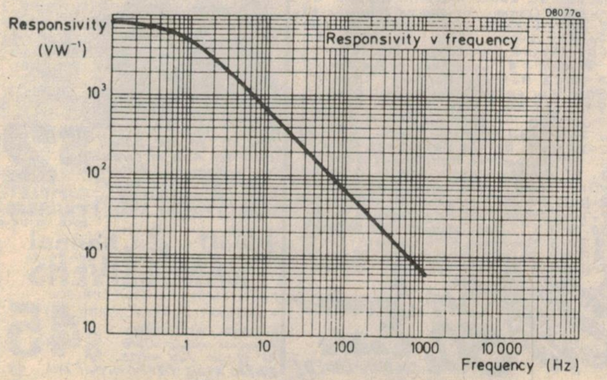
Note: Noise equivalent power is defined as the RMS value of the incident, chopped, radiant power necessary to produce an RMS signal to RMS noise ratio of one. The RMS noise refers to the value calculated for unit square root bandwidth $VHz^{-1/2}$.

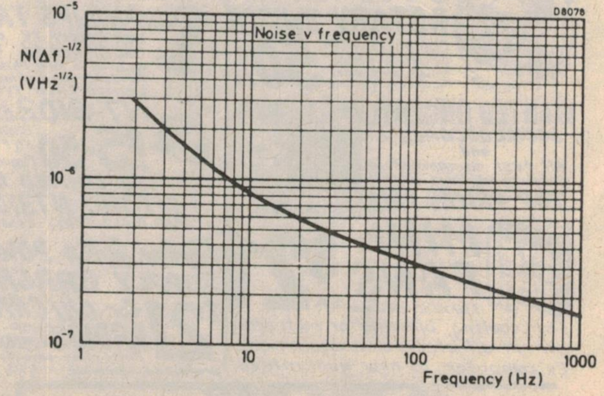
Further information on this device can be obtained from: Philips Industrial Holdings, Elcoma Division, 67 Mars Road, Lane Cove, NSW 2066. Ph (02) 427 0888.





RPY86





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against mechanical shocks. This case also accepts the standard accessories (two probes with leads, crocodile clips, direct application probe, and spare probe). The manual is first class, in a style similar to HP's calculator manuals, with plenty of examples and clear, concise explanations illustrated diagramatically where necessary.

One thing we aren't keen on in the operation of the meter is that on initial power-up, the display contains random garbage and the keyboard is inoperative – the machine has to be manually reset. Why some form of power-on reset circuitry wasn't included is a question for the designers. It is only a minor inconvenience, but one feels it shouldn't be there.

Optional extras

Several extras are available to increase the versatility of the Model 4100. For a start there's the usual things, like a battery eliminator, an adaptor plug to accept banana plugs, a soft pouch, RF probe, current shunt, clamp-on current probe and standard probe set. Then there are the accessories which are unique to the Calcumeter: a foot switch to augment the HOLD key, a temperature probe and a serial ASCII interface.

Perhaps the most powerful peripheral (I do not use the term loosely), and one which will induce many people to buy a Calcumeter, is the Model 4142 Data Logging Printer. Under external control the printer/meter combination will data log measurements continuously, on manual command, or at preselected intervals from three seconds to more than three hours. The printout is on ordinary adding machine tape, in formats up to 12 columns wide, and may be run off 12 V dc power.

Summing up

The Calcumeter is a bit of a 'dream machine' for many people who would have no use for many of its functions. Certainly equivalent meters are available at lower cost. But if one can make use of the special measurement modes, particularly in data logging applications, the Calcumeter is a very sophisticated and powerful machine indeed.

Our review model was supplied by Scientific Devices Australia Pty Ltd, 2 Vautier Street, Elwood 3184. Tel (03) 91-2223. In NSW tel (02) 76-8069. In SA, tel (08) 25-56575.

At the time of going to press, the price of the Calcumeter and its accessories were (excluding sales tax): Calcumeter, $408.00; Battery eliminator, $15.00; Data logging printer, $332.00; Temperature probe, $80.00.

Manufacturer's Specifications — Calcumeter 4100

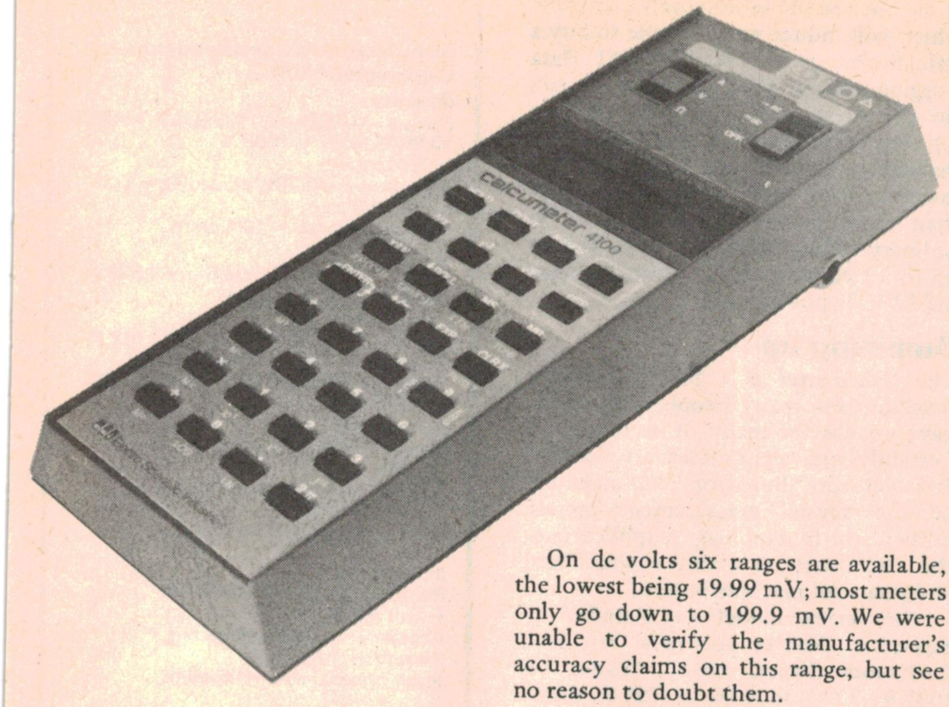
dc volts
Ranges — 19.99 mV 1999.9 mV 1.999 V 19.99 V 19.99 V 1000 V
(± full scale)
Accuracy — ±(0.25% of reading + 1 count + 50 μV)
Input impedance — 10M ohms

ac volts
Ranges — 19.99 mV 199.9 mV 1.999 V 19.99 V 1999.9 V 750 V
(± full scale)
Accuracy — ±(1% + 2 counts + 1 mV at 400 Hz, >1% harmonic distortion)
Input impedance — 10M ohms shunted with <50 pF

dc current
Ranges — 1999 mA 1999.9 mA
(± full scale)
Accuracy — ±(0.35% of reading + 1 count + 50 μA)
Input impedance — ≈1.6 ohms

ac current
Ranges — 19.99 mA 199.9 mA
(± full scale)
Accuracy — ±(1.2% of reading + 2 counts + 1 mA)
Input impedance — ≈1.6 ohms

Resistance
Ranges — 199.9Ω 1.999 kΩ 19.99 kΩ 199.9 kΩ 1.999 MΩ 19.99 MΩ
Accuracy — ±(0.30% of reading + 1 count + 0.6 ohms)
Open circuit voltage — ±5 V



The multimeter circuitry of the Calcumeter is quite comprehensive and offers measurement of current and voltage, both ac and dc, as well as resistance measurements. Range selection can be either manual (through the keyboard) or autoranging, although autoranging performance is usually preferred, both for ease of use and selection of best resolution.

The display formatting of the calculator also applies in the measurement modes, so that the display will indicate millivolts, (for example) by setting the exponent field to -03, if in the engineering display mode.

Two methods of measurement control are available; the HOLD key initiates a single measurement and returns the result in the x register (display). The CONT key allows continuous measurement, however power consumption is heavier in this mode and it is not recommended for battery use.

We found this to be a little awkward to use, with one hand for each probe, as we needed a third hand to operate the HOLD button. However, a little practice soon helped and using the crocodile clip on the earth probe frees one hand. The retention of the reading in the display is a definite advantage, though a switch on one of the probes would be a better way to initiate the measurement.

As a check on calibration, the Calcumeter was compared with our Fluke 8600 4½ digit DMM in the lab. Both instruments agreed closely on all functions, so it seems the Calcumeter meets the manufacturer's specification.

On dc volts six ranges are available, the lowest being 19.99 mV; most meters only go down to 199.9 mV. We were unable to verify the manufacturer's accuracy claims on this range, but see no reason to doubt them.

Special functions

Most of the functions examined thus far are standard on most calculators or multimeters, but the Calcumeter also includes several functions designed to enhance its unique 'dual personality'.

For example, a common problem faced by engineers is that of working out the value of two resistances in parallel. The Calcumeter offers a special mathematical function, xy/(x+y), which performs this calculation with just one keystroke. In addition, the function xy/(x-y), also provided, will calculate the value of resistor required to go in parallel with another to make up a specified resistance value.

Most calculations involving reactances and tuned circuits involve the term 2π, and so this key is provided rather than π alone.

As well as keys which perform functions in the calculator mode, some keys operate directly on measured values before the result is returned to the display. A common calculation is scaling and offsetting a measurement, such as to convert the output from a thermistor into a temperature value. This calculation always takes the form $7 = mx + b$. This may be performed on each measurement as it is made.

To do this, the multiplying factor m is stored in the memory and the offset is stored in the y register of the stack. The mode key (shift) mx + b is then depressed, and the measurement is made using the HOLD key. The result appearing on the display is automatically scaled and offset, and can even be in degrees F and C, whichever you prefer!

Of course, the same function will also operate in the CONT mod of operation, enabling rapid set-up of a temperature control circuit, for example. (A temperature probe is available as an optional extra for the Calcumeter).

Another neat trick is the automatic averaging of measurements. To take, say, ten measurements and average them one simply stores 10 in the memory, presses (shift) AVG, and then the HOLD key. This initiates the series of ten measurements. After each, the Calcumeter displays the updated average in the display. Finally, the meter stops, with the result in the display. A very useful feature indeed.

Pressing the CONT key in this mode will make the device display a continuously updated average until HOLD is depressed.

Conversion of voltage measurements to dB relative to another reference value is tedious if many measurements are to be made. Once again, Calcumeter to the rescue! If the reference value is stored in the memory, then the (shift) dBV keys depressed, any subsequent voltage measurements will be expressed in dB relative to the pre-stored value.

For percentage deviation calculations, again, the same function is supplied. Labour saving, indeed.

An application which sometimes arises in industry is the sorting of resistors by value within certain limits. Guess what! Yes, this intrepid machine will even perform this function automatically, giving the display in the form of a bar graph. Say you wish to sort 1 k resistors into eight groups between 950 and 1050 ohms. The limits are stored in the memory and y registers, and the (shift) LIMITS keys depressed. When a measurement is made, the display will now divide into eight equal areas divided by seven dots, and a bar will illuminate in the appropriate area. Pressing the DSP key will reveal the measured value of the resistor, returning the graph into the display when released.

Subsequent measurements will operate in the same way, until the (shift) NORMAL key returns the meter to normal operation (this also holds for the other special measurement modes). If the resistor value falls below the lower limit, the meter will display *-Error*, if it is above the upper limit it will display *Error*.

The (shift) INV key will automatically calculate the inverse of any measurement and may be used, for example, to calculate conductance instead of resistance.

The meter includes a beeper which audibly informs the operator of an error. It may be disabled if not required.

The Calcumeter comes packaged in a solid case clearly designed to protect

Multimeter/calculator is a powerful tool

The Calcumeter 4100 reviewed

Les Bell

ONE OF THE major conceptual difficulties people experience in electronics is that only very rarely can one measure a quantity of interest, for example the gain of an amplifier. Often, one has to measure something (or several things) else, and then perform some calculation to finally arrive at the quantity required.

For example, current — it's often too much trouble to break the circuit, insert an ammeter or multimeter and then restore the circuit. Instead, one measures the voltage across a known resistance in the circuit, and then uses Ohm's Law to calculate the current.

Surely, you say, in this sophisticated, microcomputerized world something can be done to make life a little easier. You're right — and a company called Electro Scientific Industries has done it.

The Calcumeter 4100 combines a 3½ digit multimeter with a microprocessor-based calculator and controller, so that measurements can be made and calculations performed on them immediately, even automatically. A sophisticated selection of special measurement modes allows automated calculation such as scaling or removal of offsets, or even the graphic display of a value between preset limits!

Multimeter functions

The multimeter measures both dc and ac voltage and current as well as resistance, and is autoranging on all functions. The specifications are pretty standard for a meter of this type, except for the provision of a 19.99 mV scale — unusual for a meter with these capabilities.

What makes the Calcumeter unusual is its internal organization and the way it operates. It uses a custom CMOS microprocessor instead of a dedicated chip as in other meters.

Because of this, the Calcumeter offers some options in the way it operates. For example, two keys offer either the capabilitiy of making a single measurement and holding the result in the display — a must for computational procedures — or making continuously updated measurements. In addition, the range is set through the keyboard; for example, on dc volts, range 5 measures up to 199.9 V (all these ranges are indicated on the back of the instrument), while range 0 is auto-ranging for all measurement modes.

As a calculator

The Calcumeter operates in Reverse Polish Notation (RPN) and is rather reminiscent of a Hewlett Packard calculator.

It has one memory register plus a four-level operational stack, and features all the usual arithmetic functions plus logs to base e and base 10, exponentiation and power raising, and a 2π key — a novel touch and quite useful.

The display can be controlled in much the same way as an HP calculator and can be set to FIX and ENG display modes.

Calculation is performed to an internal accuracy of eight digits, although all measurements are only accurate to 3½ digits, a point which must be borne in mind when calculating on measurements. All eight digits can be displayed by pressing the DSP key twice; releasing it returns the display to its normal five digit mantissa plus two exponent form.

The keyboard is quite clear and uncluttered. Some nice touches have been added to the calculator: for example, when the M+ or other memory math key is pressed, the display shows the updated value of the memory contents. When it is released, the display returns to the X register.

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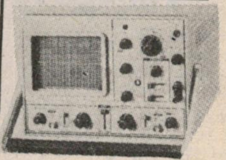

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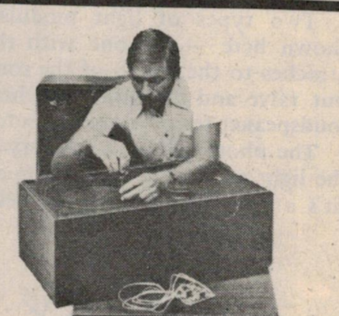

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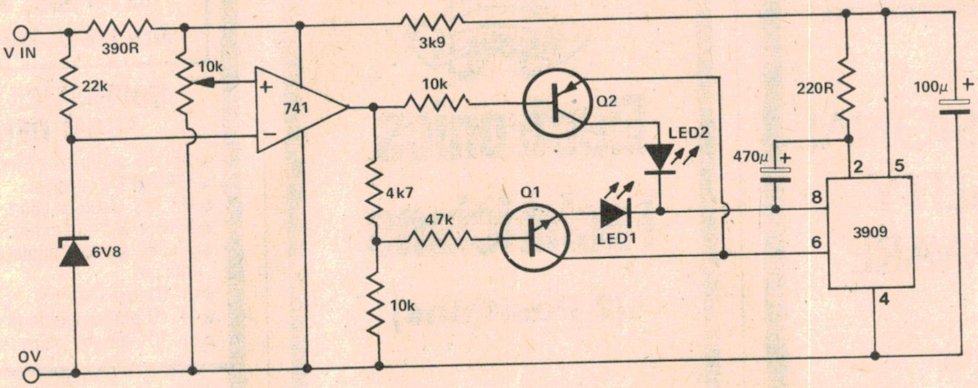
Ideas for Experimenters



Voltage level indicator

This circuit, by Fred Zickar of Bellambi, indicates the state of nickel-cadmium batteries in portable equipment.

LED 2 indicates a low battery voltage and the 3909 IC will make it flash when this occurs. The 3k9 resistor in the 3909 supply line varies the brightness of the LEDs. You can change it to suit ambient lighting conditions. The potentiometer sets the required 'battery OK' voltage. The circuit draws less than 10 mA.

TV opto-isolator

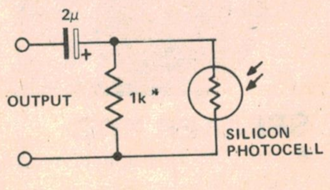
The problem of how to connect a TV's sound to an amplifier or tape recorder is basically one of safety — TV sets use very high voltage. One approach is to pick up the IF from the set, but this requires that you strap a coil onto the back.

One way of getting an audio signal out without the risk of high voltage outside the set is to use an opto-isolator.

This uses circuitry which converts the audio into a changing light level, and then detects this modulated light using another stage — electrically isolated from the first.

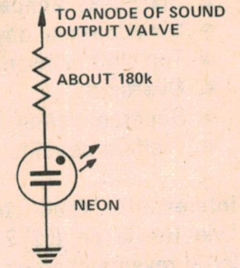
Two types of light modulator are shown here — the one with the neon attaches to the anode of the sound output valve and the other attaches to the loudspeaker terminals of the set.

The photocell has to be very close to the light producing part of the circuitry (it's a good idea to tape the cell to the neon or LED — but be careful that you preserve the electrical isolation) and shielded from outside light sources. The output of the detector is probably best fed to the most sensitive amplifier input you have, as the amplitude will be small.

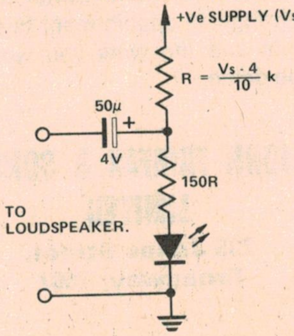


* ADJUST FOR MINIMUM DISTORTION

TRANSMITTER 1



TRANSMITTER 2



Mods to Project 148, versatile logic probe

Melbourne reader Les Fitch phoned to tell us that buffered type CMOS chips 4049s or even 4009s could be used in this project, but to get correct operation over the range of supply voltages from 5 V to 15 V, resistors R2 and R3 should be changed to a value of 1M each.

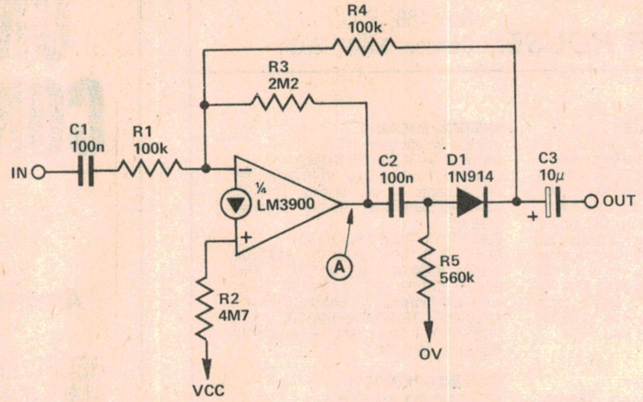
Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

Ideas for Experimenters

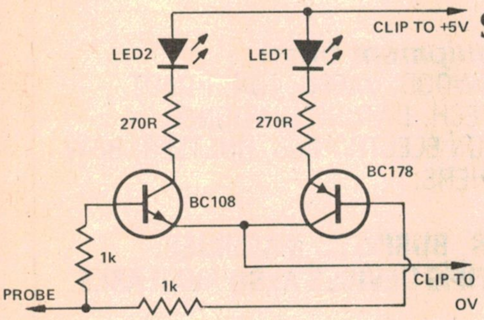
Precision rectifier



The LM3900 is different from most op-amps in that it is current-differencing and operates from a single supply rail. Standard precision rectifier circuits are not applicable for this device but the circuit shown here works well.

Two feedback paths are provided — R3 for dc stability and R4 for the ac signal after C2 and R5 have filtered out the dc bias. When R2 = 2 x R3, point A will be at half the supply voltage, allowing the diode to be reversed by the input signal.

For large positive input, input impedance equals R1 and voltage gain is — R4/R1, since R4 is made much smaller than R3. C1 and C3 are dc blocking capacitors and determine the low-frequency roll-off.

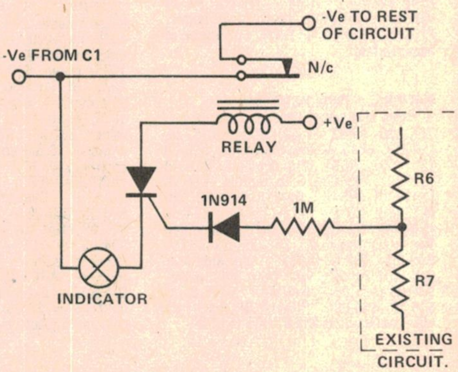


Simple logic probe

This probe is so simple in its operation that it needs almost no explanation. None of the components are at all critical. The circuit may be of use in designing a larger unit, with perhaps one of these probes for each of the pins of an IC clip.

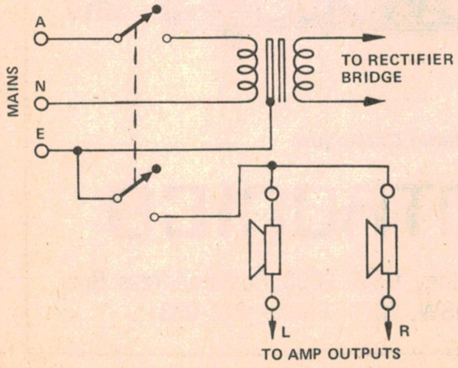
It might be a good idea to make the LEDs different colours, so that the state of the circuit under test can be seen at a glance. The NPN transistor (the left-hand one) will turn on the left-hand LED if the voltage on the test probe is high (nearer the + supply rail). The other LED will come on if the probe voltage is near zero.

Short circuit protection for ETI 132



John Peschar of Marks Point found that the overload indicator of his ETI 132 power supply gave insufficient warning. He developed this circuit which cuts the output of the supply when the current drawn reaches approximately 1.3A, latches and turns on an indicator to show that an overload condition has occurred.

The SCR used in his device was a C106D1, which had sufficient current capability to drive the indicator he used. D1 can be almost any silicon diode. It prevents feedback from the SCR gate to the rest of the circuit.



Pop killer

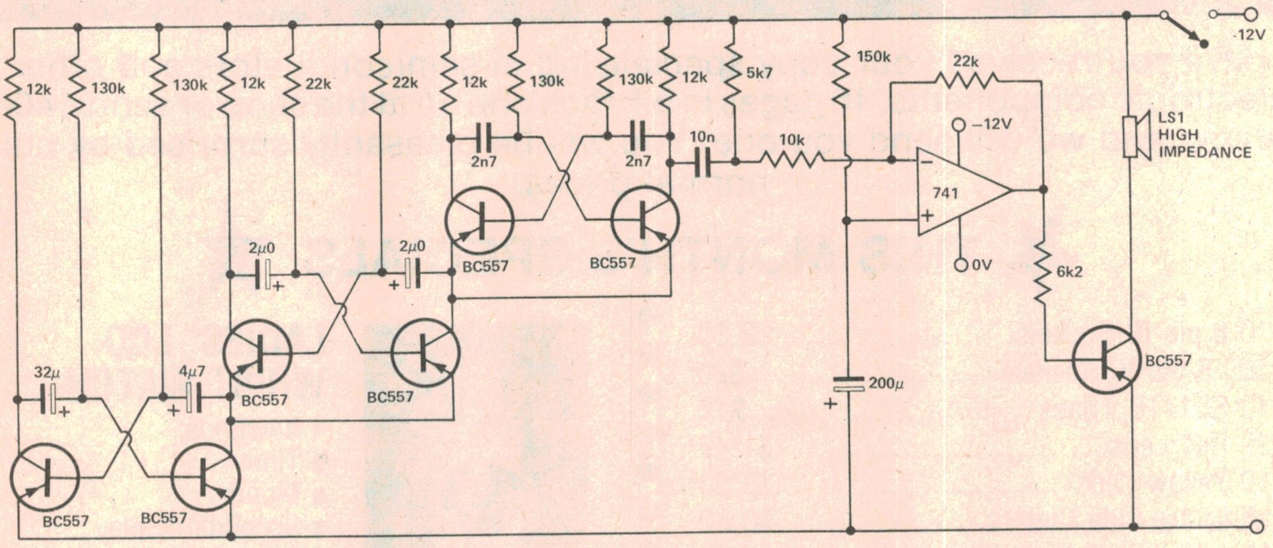
After building a small 12 W/channel amplifier, **Brian Modra** of Elizabeth Vale set about developing a means of stopping it from making annoying pops and bangs as it was switched off.

This little circuit uses only a double-pole switch (which must be capable of handling mains) which cuts off the speakers at the same time as the power is switched off.

Unfortunately, this circuit is not suitable for use with bridged amplifiers, but a little thought and a three pole switch should sort things out.

Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



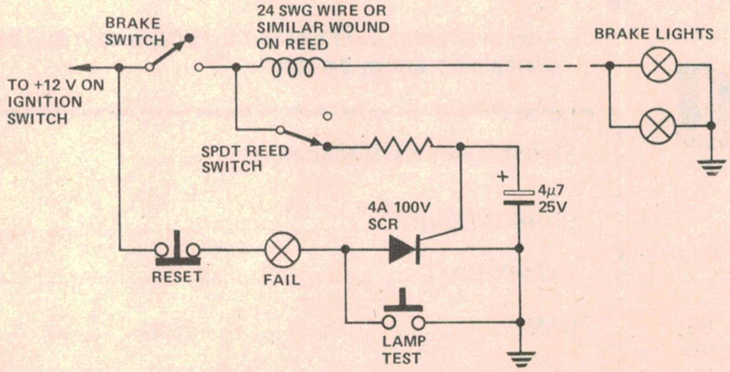
Gentle clock alarm

RING! RING! BUZZ! CLANG! PIP PIP!

This is hardly the sound that anyone wants to hear first thing in the morning (especially one of *those* mornings!)

There are gentler ways to wake up. This circuit provides an alarm which builds up from being inaudible to fairly loud over the course of about a minute. As a result, you are always woken up by the minimum volume required to wake you: a far more comfortable experience than the usual trauma!

The three multivibrators are connected so that the first two modulate the power supply of the third. The resultant signal is a rather pleasant warbling sound. This is shifted in dc level by the voltage at the non-inverting input of the op amp, and since this voltage is provided by R and C, it will rise slowly, shifting the signal in dc level and thus increasing the dc bias of the transistor. Thus the output of the circuit will rise slowly in volume.



Car lamp failure warning

Many lamp failure warning circuits indicate only when the lamp being monitored is supposed to be on. This circuit will 'latch' to show that the brake lights are faulty – even if the fault is intermittent, as is often the case with wiring faults.

Enamelled copper wire is wound onto an SPDT reed switch until a certain number of turns is found (by experiment) that will open the contacts when both lamps are working. If either of the lamps should fail, the contacts will remain closed, triggering the thyristor.

Shoparound

THIS PAGE is to assist readers in the continual search for components, kits and printed circuit boards for ETI projects. If you are looking for a particular component or project — check with our advertisers if it is not mentioned here. Also, for a list of suppliers who stock the ETI projects published over the last 2½ years, our "Kits for Projects" page may always be found on the page immediately before the DREGS page (inside the back cover).

Printed circuit boards

Printed circuit boards for *every* project *ever* published in ETI are available from:

RCS Radio
651 Forest Rd
Bexley, 2007 NSW

Radio Despatch Service
869 George St
Sydney 2000 NSW

We have arranged to supply firms handling our projects with pc boards and front panel artwork in advance of publication commencing with the August 1979 issue. To date, the following firms have subscribed to this scheme and will have boards available for current projects before, or very soon after, publication of each issue:

Applied Technology, Sydney
James Photronics, Adelaide
Jemal Products, Perth
Mini Tech, Auckland N.Z.
RCS Radio, Sydney
Rod Irving Electronics, Melbourne

The following firms stock pc boards for a variety of ETI projects, past and present:

All Electronic Components, Melb.
Rod Irving Electronics, Melb.
Tasman Electronics, Melb.
Willis Trading, Perth
Dick Smith Electronics, all over

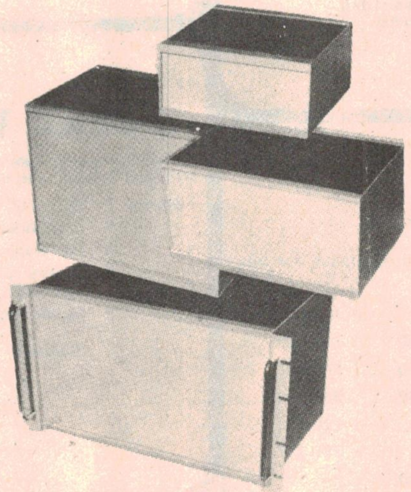
Strobe

Most kit suppliers have indicated that they will be stocking complete kits for this project.

For the resourceful constructor not starting from scratch, the strobe tube (type MFT1210) and trigger transformer (type TR4KN) are available from Circuit Components in Sydney and All Electronic Components in Melbourne. Dick Smith stocks a suitable strobe tube (Cat. No. S-3882) and trigger transformer (M-0104) also.

The RIFA, type PHN, 6 uF capacitors are rated for 240 Vac operation and are commonly used in fluorescent light installations. They are available from electrical wholesalers such as George Brown and Martin de Launay in Sydney (take packed lunch!). They are also available from All Electronic Components in Melbourne and Dick Smith Stores.

Various reflectors can be used, they are a common photographic item, but the kit suppliers will have them specially-made to suit the project.



Instrument cases

If you like to impart that 'professional look' to your projects then you'd almost certainly be interested in the range of instrument cases being marketed by Melbourne firm, Adaptive Electronics.

Simple to assemble, versatile, smart looking and very competitively priced, there are a range of sizes in stand-alone or rack mount models. Each case is supplied in knocked-down form and consists of :—

(a) Satin anodised 1.6 mm aluminium front and back panel, with surface suitable for screen printing etc.
(b) Top and bottom panels of hard wearing black "Marviplate" with a 1.0 mm steel base.
(c) Side panels of satin anodised 3.00 mm aluminium (m series) and 13 mm timber (w series).
(d) Four specially designed aluminium extrusions are used to hold the top, bottom, front and back panels in position. Provision is also available on the extrusion for mounting a metal chassis, circuit boards or edge connectors.
(e) Only eight screws are necessary four through each end plate to complete the assembly.

Options available are:

(1) The front and rear panels can be replaced with 3.0 mm satin anodised aluminium.
(2) The bottom panel can be replaced with 3.0 mm satin anodised aluminium.
(3) Side panels can be of the rack mounting type, handles also provided.

The popular models are the W502 (wooden ends) and M502 (metal ends), the first measuring 144 mm high by 438 mm wide by 290 mm deep; the second being 134 mm high by 419 mm wide by 280 mm deep — the rack mount option being most popular.

In fact, our very popular Series 4000 stereo amp was housed in an Adaptive Electronics model M702 case with the rack-mount end plates.

If you're interested, we suggest you call or write for a brochure; Adaptive Electronics, 77 Beach Rd, Sandringham 3191 Vic, (03) 598-4422. The cases should be available shortly through a number of suppliers in other states.

Series 4000 stereo amp.

So far as we can ascertain at time of going to press, the following companies are stocking *complete* kits of the Series 4000 Stereo Amplifier project, including cabinets, front panels and all modules.

Applied Technology, Sydney
Electronic Agencies, Sydney

The individual modules are available separately or as kits from the following suppliers (apart from the above two):

All Electronic Components, Melb.
DR Hi-Fi and Electronics, Sydney
Ellisttronics, Melbourne
Jaycar, Sydney
Mode Electronics, Sydney
Pre-Pak, Sydney
Radio Despatch, Sydney
Rod Irving Electronics, Melbourne
Silicon Valley, Sydney, Melb., Bris., Adelaide & N.Z.
Tasman Electronics, Melbourne

Scotchcal panels

Radio Despatch Service in Sydney have advised that they will be able to provide Scotchcal front panels and meter scales for ETI projects in red, blue or black on silver background.

All new projects, and a number of past ones, which use Scotchcal front panels will be stocked.

Radio Despatch Service are located at 869 George St, Sydney; (02) 211-0816.

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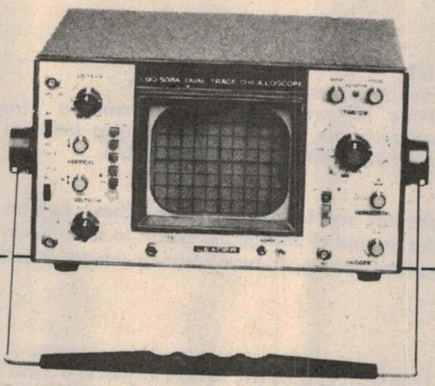

Model LBO-508A. A dual trace oscilloscope with 20MHz bandwidth and 10 mV/cm sensitivity. Multiple mode functions. 130 mm CRT produces a bright, sharp display. Display offers chop, alt., add and subtract Ch. 1,Ch.2,X-Y

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WESTERN AUSTRALIA
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Perth.
(09) 321 0101

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George Brown & Co.
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Canberra.
(062) 95 0455

VICTORIA
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West Melbourne, and
Dandenong Road.
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93 Sackville Street.
Collingwood.
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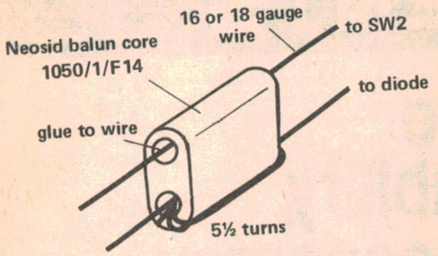
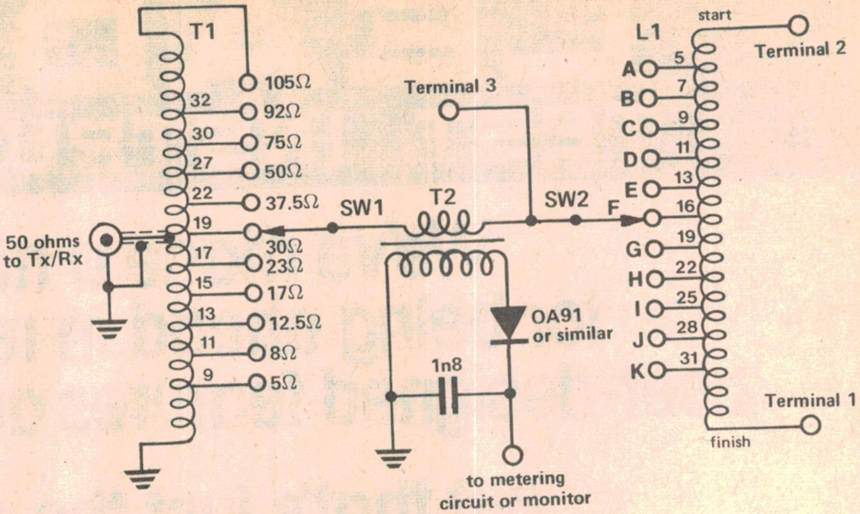
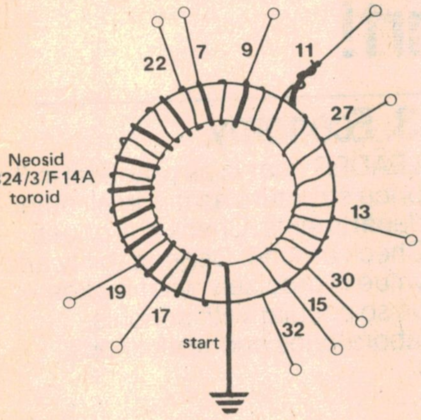
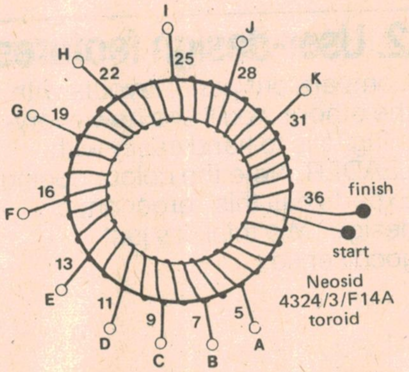


T2







COMPONENTS

The 4324/3/F14A toroid (two needed) and the 1050/1/F14 balun core are available from Neosid Pty Ltd, 23-25 Percival St, Lilyfield NSW and from Watkin Wynne Pty Ltd, 32 Falcon St, Crows Nest 2065 NSW.

All other components are generally available.

T1

Neosid ferrite toroid, type 4324/3/F14A (38.1 mm o.d. by 25.4 mm i.d. by 12.7 mm high, F14A ferrite material)
Total of 32 turns of wire wound twice around the core. Use 14 or 16 swg enamelled wire for the first 11 turns and 18 or 20 guage for the following 21 turns; taps as indicated.

L1

Neosid ferrite toroid as for T1.
Wind 36 turns of 28 swg enamelled wire around core, leaving an 8 mm gap between start and finish; taps as indicated.

Figure 1. **Circuit diagram and winding details for the coil and transformers. Note that a variable capacitor may be connected between terminal 3 and ground to change the circuit to an L-match type rather than simple coil loading. The 11-position switches must have contacts rated to stand the RF current for the power level used.**

is passed through one hole of a dual-hole balun, a Neosid type 1050/1/F14, which is glued in place. This forms the primary of the transformer. The secondary consists of 5½ turns of a light gauge enamelled copper wire or hookup wire wound through the other hole as illustrated in Figure 1. One end goes to ground, the other end goes to the diode rectifier circuit. The metering circuit may simply be a preset potentiometer in series with a suitable meter. Appropriate components are best determined by trial and error to suit the particular situation and power level of an installation.

In practice, SW1 and SW2 are adjusted for maximum antenna current as indicated by the metering circuit on T2. Alternatively, if an SWR meter is inserted in the transmission line between the transceiver and the tuner, adjust SW1 and for the lowest SWR or least reflected power. Do not operate SW1 and SW2 while power is applied.

The line to the transceiver from T1 is shown connected to the 50 ohm tap (22nd turn) in Figure 1. If a 75 ohm system is used, this may be connected to the 27th turn.

T1 works well between 1.5 MHz and about 7 MHz for all the impedance taps for 105 ohms down to 17 ohms. The lowest three taps only provide reasonable impedance transformations between 1.5 MHz and 3 MHz.

The tuner is suitable for use at power ratings up to 500W CW or PEP, providing sufficient care is taken with insulation, particularly with points that may carry reasonably high voltages. ●

A versatile antenna tuner covering 1.5 MHz to 7 MHz

Roger Harrison VK2ZTB

This unit will match a wide range of resistive and reactive impedances, commonly encountered with short or loaded antennas widely used in this frequency range, matching to 50 or 75 ohms. Locally available components are specified.

ANTENNAS for frequencies between 1.5 MHz and 7 MHz are usually limited in size by the amount of real estate available. Full sized quarter-wave verticals are difficult to achieve so one usually arrives at some sort of compromise. This often takes the form of a random length of wire, as long as possible and strung as high as possible. Loaded verticals are also used.

The feedpoint impedance of such compromise antennas is often lower than the 50 or 75 ohms at the transceiver antenna terminal, and is very often reactive – usually capacitive, particularly if the antenna is 'short' at the working frequency.

Most mobile antennas for these frequencies, particularly 'helical' wound whips, exhibit similar characteristics.

A good solution is to use a tapped auto-transformer in conjunction with a variable inductor. The circuit of this combination as shown in Figure 1. The tapped auto-transformer, T1, is wound on a large Neosid toroid (432/3/F14A). It consists of 32 turns of enamelled copper wire wound twice around the core as illustrated. The first 11 turns are wound with 14 or 16 gauge (swg) wire spread about two-thirds of the way around the core. The following 21 turns are wound with a lighter gauge wire such as 18 of 20 gauge. The taps are placed at intervals which give convenient impedance transformations.

Taps can be made in one of two ways. Where the wire for the appropriate turn passes across the outer face of the toroid, it can be lifted slightly when it is wound on. The insulation is then scraped off each tap after completing the whole winding and a wire soldered on to the tapping point, taking care not to cause shorts to adjacent turns.

Alternatively, the whole winding may be completed and the insulation scraped off portion of the wire at the appropriate turn, attaching a wire at each tap. This requires a little more care and skill, but the toroid is much easier to wind. Be careful when identifying the correct turn for each tap. For the taps at turns 7, 9 and 11 use 24/0076 hookup wire, or something heavier, to make connections to the switch contacts on SW1.

The switch, SW1, is an eleven position rotary switch with fairly heavy contacts. This is an expensive item but is sometimes found in ex-disposals equipment. Alternatively, a banana plug and eleven sockets may be used, and is quite economical.

The variable inductor may be a roller inductor which was used in a similar tuner described by Rod Champness VK3UG in the May 1976 issue of the Radio Bulletin. These devices are as scarce as hen's teeth these days but can occasionally be scrounged from ex-disposals gear – some people may have them in their junk box.

A commercially-manufactured version of this circuit uses a permeability-tuned coil. A length of ferrite rod is manually moved in or out of a coil to vary the inductance. Both of these variable inductors are elegant solutions in that they provide an infinitely-variable inductance, but both are difficult to physically realise if you are forced to construct them yourself. The next-best thing is a tapped coil.

The tapped coil, L1, is illustrated in Figure 1 also. It consists of 36 turns evenly spaced around the cirumference of the large Neosid toroid of the same type used for T1. Taps are made at positions which provide convenient intervals of inductance. These are made in the same way as on T1. SW2 may be an eleven-position switch as for SW1 or a banana plug and sockets as suggested previously.

The antenna is connected between either of terminals 1, 2 or 3, and ground. If connected to terminal 1, SW2 provides relatively small increments of inductance, the percentage change increasing as tap K is approached.

If the antenna exhibits a large resistive impedance at the feedpoint, it can be connected between terminal 3 and ground.

The transformer T2 is used as a current transformer to provide a convenient signal for a metering or monitoring circuit. The wire connecting SW1 and SW2

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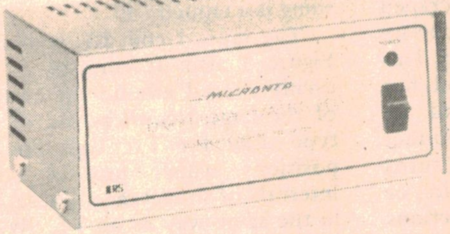

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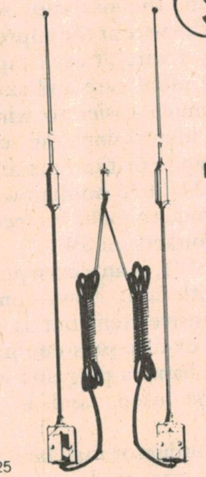

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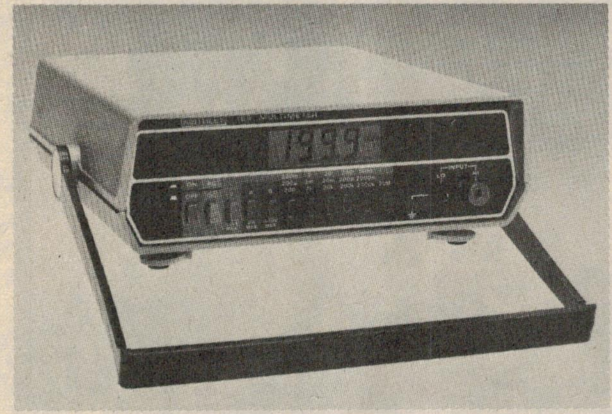

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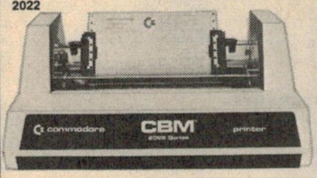

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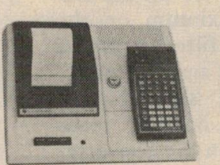

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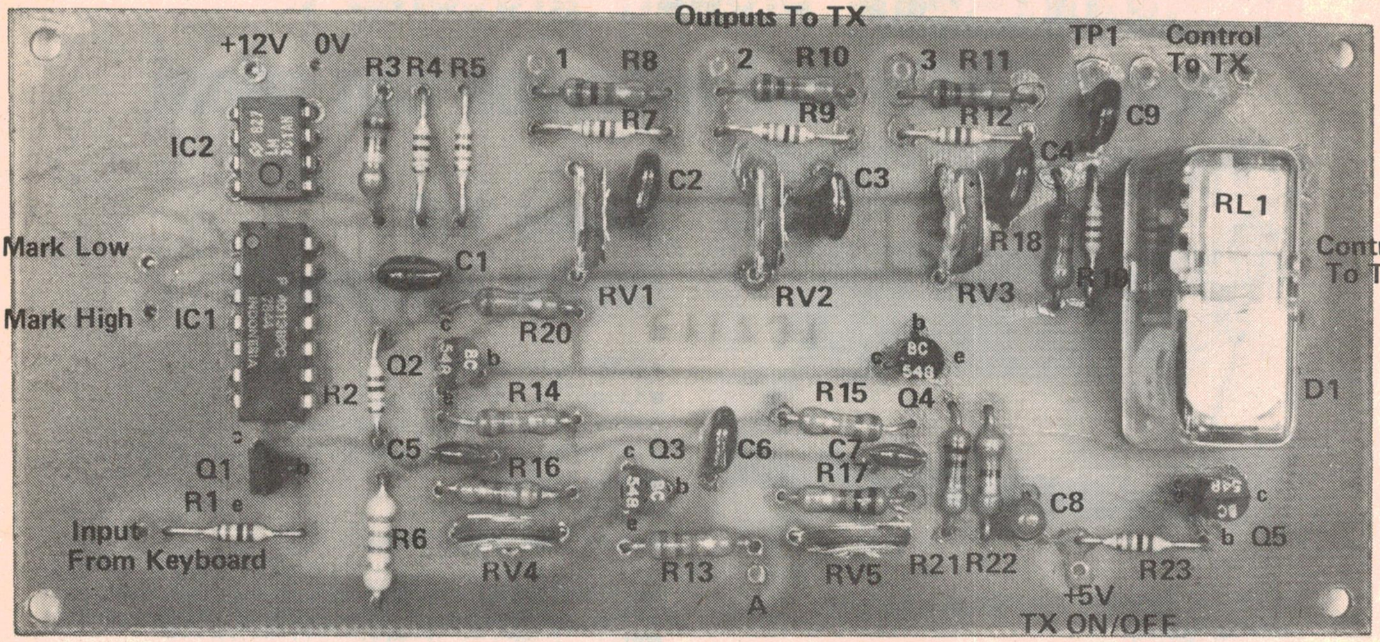


Our overlay diagram for this project is something of an experiment. Reader comments are invited.

Construction

There is nothing in particular to watch out for here, except the CMOS IC (IC1). Keep it in its foil or conductive foam until ready for insertion, then solder the power pins 7 and 14 first. Install the rest of the parts in the usual way with the exception of R14, R16, R17 and R18, the values for which will be selected during alignment.

Alignment

For best accuracy a frequency counter is required. If you don't have access to one the receiving converter can be used to set the oscillator frequencies. In this case adjust the receiver to an off air signal known to have 170 Hz shift, and then connect it to the output of the oscillator. Use a CRO or VTVM to monitor the filter outputs while adjusting the tone frequencies.

Begin with the low tone, selected by earthing the logic input (if the phase coherent option is used be sure it's switched to 'mark high').

Adjust RV5 for 2125 Hz on the frequency counter (or maximum on the receiving converter space filter). Connect the logic input to +5 volts and the modulator frequency should shift higher. Adjust RV4 until the counter reads 2295 Hz (or maximum on the converter mark filter). Go between mark and space a couple of times as there is slight interaction.

Resistors R16, R17 and R18 are selected to provide the desired output levels to the transmitters and cassette recorder. To set them up, connect an output to a transmitter's microphone input, and then select the resistor to provide the desired power output. RV1, RV2 and RV3 can then be used for fine adjustment. TP1 can be connected back to the receiver demodulator to check the modulator output during transmit.

If an oscilloscope is not available R14 should be left out.

The modulator accepts logic-level signals and can be run directly from a TTL-output baudot keyboard or, by tapping a signal from the emitter of Q2 on the receiver decoder board (730), can be driven from the keyboard of the older-style teleprinter machines. The block diagram opposite shows the transceiver system.

(to be continued).

RADIOTELETYPE GROUP

The Australian National Amateur Radio Teletype Society (ANARTS) caters to persons interested in this mode of communications. Formed about two years ago, the Society has around 500 members throughout Australia. Based in Sydney, the group may be contacted through Peter Mulligan at 52 Houghton St, Yagoona 2199 NSW; phone (02) 709-6060 after hours or (02) 519-5855 during business hours.

The group can supply information on teleprinter machines, where they may be obtained, how to service them etc, as well as supply a number of kits for radio-teletype applications — including the projects in this series of articles.

PARTS LIST - ETI 731

Resistors	all ½ Watt, 5%
R1, R2	10k
R3	150k
R4, R5	10k
R6	330R
R7	See text
R8	1k
R9	See text
R10, R11	1k
R12	See text
R13	22k
R14, R15	12k
R16	3k3
R17	1k
R18	2k7
R19	See text
R20	18k
R21	1k
R22	470R
R23	10k
Potentiometers	
RV1—RV3	5k miniature trim pot
RV4	1k miniature trim pot
RV5	470R miniature trim pot
Capacitors	
C1—C4	22n greencap
C5	10n greencap
C6	22n greencap
C7	10n greencap
C8	1µ 16V electro
C9	22n greencap
Semiconductors	
D1	IN914
Q1—Q5	BC548, BC108, DS548
IC1	4013
IC2	301

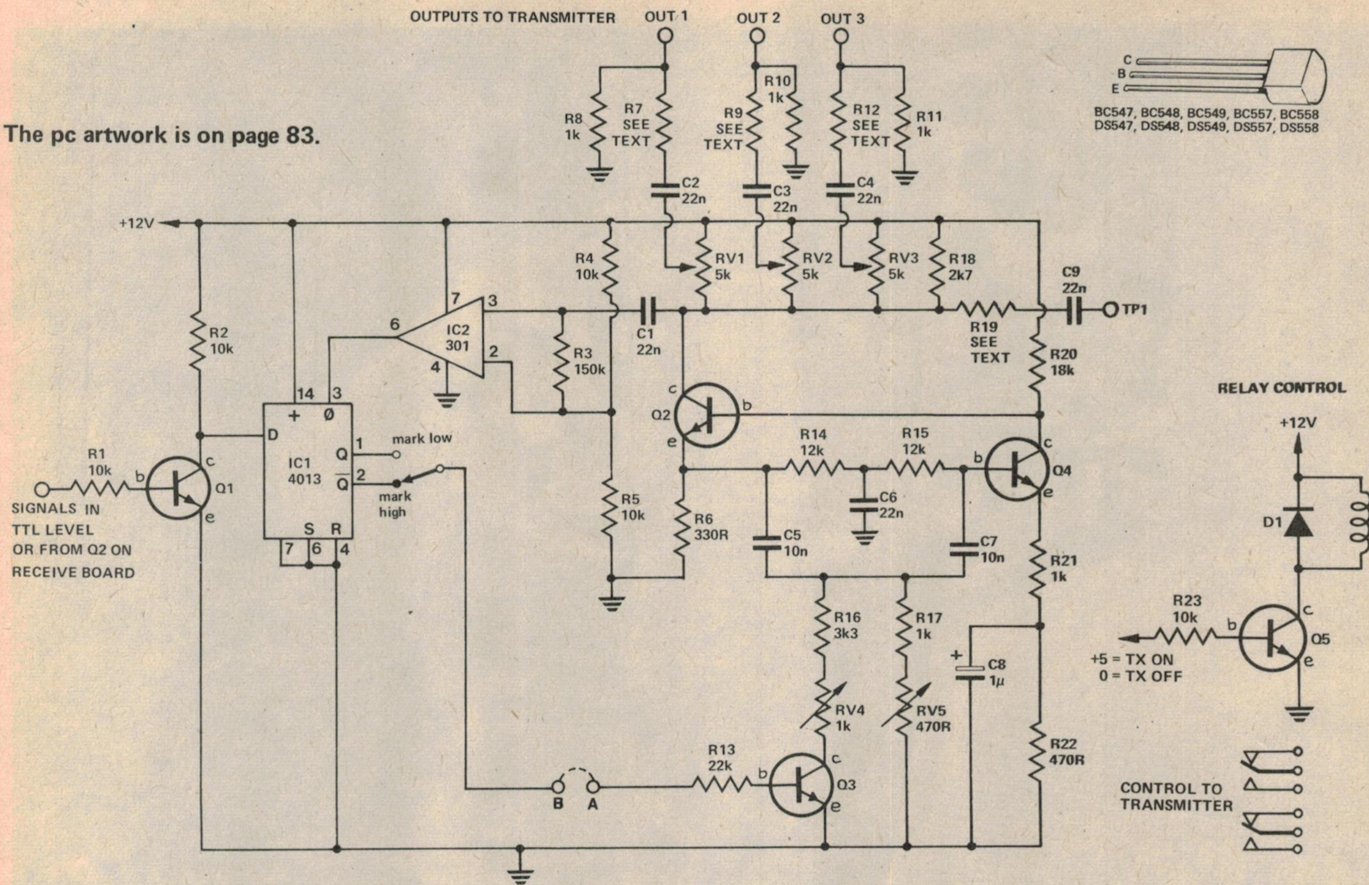
Miscellaneous

ETI 731 pc board, pc mounting change-over relay Pye Type 265/12/G2V or sim.

Errata

In last month's parts list, RV2 and RV3 were shown as 500 k - this should be 500R — the overlay and circuit are correct.

The pc artwork is on page 83.



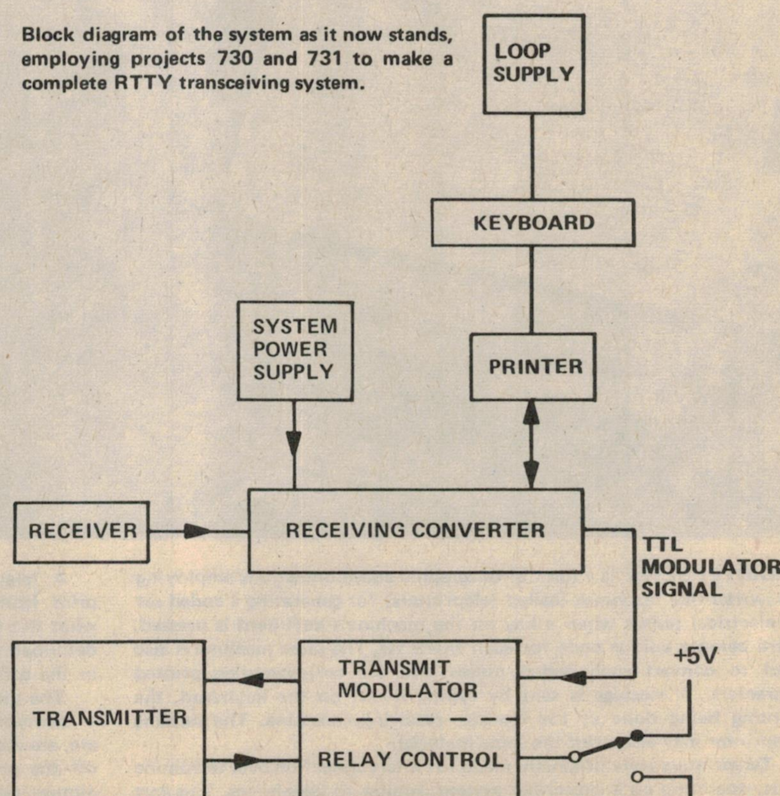
HOW IT WORKS

Transistors Q2, Q4 and associated components form a twin-T sine wave oscillator, with fine frequency adjustment provided by RV5.

When the base of Q3 is high it pulls the collector low, adding extra resistance (RV4 and R16) across RV5 and R17. This slightly raises the oscillator frequency. RV1, RV2, RV3 and R18 in parallel form Q2's collector resistor, from which the three outputs are taken. For phase coherent operation, another output is taken from Q2's collector via C1 and fed to op amp IC2, which is run 'flat out' forming a limiting amplifier. Its output is a square wave of about 10 volts peak to peak, which becomes the clock frequency for the flip-flop IC1.

Teletype data is fed via inverter transistor Q1 into the data input of IC1. The data appears at Q (mark low) or at $\overline{Q}$ (mark high) and is then fed into the oscillator switch at point A. Q and $\overline{Q}$ cannot change state to follow the input until IC1 receives a positive going clock pulse, which only occurs at the start of each oscillator cycle. So the oscillator can't 'switch' except at the start of a cycle, preserving phase coherence.

Block diagram of the system as it now stands, employing projects 730 and 731 to make a complete RTTY transceiving system.



RADIOTELETYPE is a form of telegraphic communications employing typewriter-like machines (called teleprinters) for generating a coded set of electrical pulses when a key on the machine's keyboard is pressed, there being a unique code for each character. The same machine is also used to convert such coded pulses into the corresponding printed characters. A message is sent by typing it out on the keyboard, the printing being done at the remote, receiving, machine. The sending teleprinter may also print the same material.

Teleprinters were originally made for interconnection over telephone lines, operating on a subscriber system, similar to telephones. This sort of operation is increasing with modern machines.

A teleprinter may be connected to operate a transmitter and to print from a received signal — hence, radioteletype (RTTY). That is what this short series of articles is all about. Last month, Tom Moffat described the receiving converter — we have one installed with a receiver in the office and are having great fun with an old model 15 Teletype.

The picture here (ah yes . . . the picture) shows one facet of RTTY — 'teletype art'. Amongst the usual Santa Clauses, comic strip characters etc, are more elaborate efforts such as the Mona Lisa shown here coming off the printer. Most lines are overprinted two or three times and the picture takes 32 minutes sent at the 45.45 baud rate. This represents nearly 12 000 characters.

Get going on radioteletype

Tom Moffat VK7TM 39 Pillinger Drive Fern Tree, Tas. 7101

This is Tom's second article in a short series on how to get going on radioteletype — an intriguing facet of communications. This month the transmitter modulator is described.

LAST MONTH we described the circuitry to get a teletype machine receiving signals off-air. This month we'll go into the transmitting side with a tone modulator board that generates the two standard tones, commonly used by radio amateurs, of 2125 and 2295 Hz. Even if you don't intend to transmit, this tone modulator will be useful for recording teletype signals on cassette tape. The board also includes a transmitter keying relay to control several transmitters.

There are two ways to frequency shift key an HF transmitter with a teletype signal. One is to transmit a steady unmodulated carrier for mark, and to shift it 170 Hz lower for space, by 'pulling' the frequency of the transmitter's oscillator. This usually means building a special transmitter for RTTY, or modifying an existing one.

The other method, most commonly used these days, is to modulate an SSB transmitter with two audio tones spaced 170 Hz apart. If all stages in the transmitter are linear, a single tone of 2295 Hz at its input will result in a single carrier at its output, 2295 Hz above the 'suppressed carrier' RF frequency (this assumes upper sideband operation). A tone of 2125 Hz, 170 Hz lower, shifts the output frequency 170 Hz lower.

Any SSB transmitter can be used although it must be remembered that it's being made to supply power continuously, rather than intermittently as is the case with voice modulation. As most amateur SSB transmitters are rated for voice operation only, the output power must be kept well down for RTTY operation to avoid overheating in the final stage.

The author uses an elderly valve transceiver rated at 200 watts PEP input, but it's run at about 15 watts output on RTTY to avoid showing signs of strain. But, those 15 watts have brought good signal reports from all over the world.

Modulator

The tone generator has three output level controls to allow the tones to be simultaneously fed to the mic inputs of two different transmitters and a cassette recorder. It can be built in two versions, phase coherent and non-phase coherent.

The oscillator, a twin-T type, is set up to run on 2125 Hz, extra resistance being switched in to shift the frequency to 2295 Hz. This will happen any time the input logic signal changes from space to mark, even if the oscillator is only part way through a cycle. However, if the waveform changes in mid-cycle it's no longer a pure sine wave (it's distorted), and, if fed into an SSB transmitter, the distorted part of the sine wave would result in spurious outputs.

This problem can be solved by using the phase coherent option, where oscillator switching is not allowed until a full cycle has beeen completed. In other words, each burst of mark or space tone consists of a full number of cycles.

Many popular phase coherent designs generate the tones as square waves under the control of logic circuitry. The audio square waves are then pushed through filters in an attempt to clean them up into sine waves. To really filter them properly a complex filter is required.

We've tackled the problem in a completely different way. The tones are generated as sine waves. For phase coherent switching the tones are sampled, squared, and then the square waves are fed to the logic circuitry, which prevents switching until the sine wave sample indicates a cycle has finished. The result... low distortion, and no filtering required. The logic also allows mark high/mark low selection.

If you feel the phase coherent option is not worthwhile, the whole section can be left off the board, and the teletype signals can be fed straight into the oscillator switching transistor, at point A. In this case delete R1-R5, C1, Q1, IC1, and IC2.

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2N3906	.16
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7416	.40
7417	.40
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7421	.16
7423	.35
7426	.24
7427	.24
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7450	.18
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7454	.18
7470	.35
7472	.30
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7474	.25
7475	.25
7476	.25
7480	.60
7485	.85
7486	.36
7490	.24
7491	.50
7492	.26
7493	.26
7494	.80
7495	.35
74107	.40
74121	.36
74122	.60
74123	.30
74126	.50
74132	.75
74145	.80
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4009	.65
4010	.65
4011	.18
4012	.18
4013	.42
4014	1.00
4015	1.00
4016	.41
4017	1.05
4018	1.00
4019	.52
4020	1.05
4021	1.05
4022	1.05
4023	.18
4024	.70
4025	.18
4026	1.55
4027	.60
4028	.78
4029	1.10
4030	.33
4040	.95
4041	.80
4042	.80
4043	.85
4044	.85
4046	1.30
4049	.40
4050	.40
4051	.70
4052	.70
4060	1.30
4066	.65
4068	.29
4069	.18
4070	.27
4071	.27
4072	.27
4073	.27
4075	.27
4077	.27
4078	.27
4081	.27
4082	.27
4093	1.30
40174	1.05
4510	1.05
4511	1.05
4518	1.05
4519	.65
4520	1.05
4541	1.30
4560	2.60
74C00	.22
74C02	.22
74C04	.22
74C08	.22
74C10	.22
74C14	.40
74C20	.25
74C30	.25
74C32	.25
74C48	1.40
74C73	.65
74C74	.65
74C76	.65
74C83	1.25
74C85	1.10
74C90	.85
74C93	.85
74C95	.55
74C107	.60
74C150	2.40
74C151	1.50
74C160	.80
74C162	.80
74C175	.80
74C192	1.10
74C193	1.10
74C195	.90
74C221	1.30
74C373	1.60
74C901	.50
74C902	.50
74C907	.50
74C925	4.10
74C927	4.10
80C95	.60
80C97	.60
80C98	.60

TTL 74LS SERIES

74LS00	.15
74LS01	.20
74LS02	.15
74LS03	.18
74LS04	.18
74LS05	.18
74LS09	.18
74LS10	.18
74LS11	.18
74LS14	.70
74LS20	.18
74LS21	.18
74LS22	.22
74LS26	.28
74LS27	.18
74LS28	.30
74LS30	.22
74LS32	.22
74LS33	.32
74LS37	.30
74LS38	.30
74LS40	.18
74LS42	.75
74LS51	.25
74LS54	.25
74LS55	.25
74LS73	.50
74LS74	.40
74LS75	.45
74LS85	.95
74LS86	.35
74LS90	.45
74LS92	.80
74LS93	.65
74LS107	.35
74LS109	.35
74LS112	.35
74LS123	.90
74LS125	.55
74LS126	.55
74LS132	.80
74LS138	.80
74LS151	.60
74LS154	1.20
74LS157	.60
74LS163	.70
74LS174	.60
74LS175	.60
74LS190	.95
74LS192	.70
74LS193	.70
74LS196	.90
74LS221	.90
74LS257	.50
74LS365	.55
74LS366	.55
74LS367	.55
74LS368	.55
74LS374	1.40

S.C.R.

C106Y	.30
BT100A300R	.50
C106D1	.50

DIODES

1N914	.04
1N4001	.06
1N4004	.06
1N4007	.12
1N5625	.35

ZENER DIODES

400mw 3.3 v to 36v	.12
1 watt 3.3v to 36v	.20

VOLTAGE REGULATORS

309	1.10
317	2.10
7805	.70
7806	1.00
7808	1.00
7812	.70
7815	1.00
7824	1.00
7912	1.10
7915	1.10
78L05	.35
78L12	.35
78L55	.35
79L05	.60
79L12	.60
79L15	.60

OPTO

FND 507	1.40
FND 357	1.00
FND 500	1.00

STANDARD LEDS

RED	.12
GREEN	.20
YELLOW	.25
CLIPS	.02

MICROS

2102	1.20
2114	5.50
2708	10.00

PCB MOUNT

.1 uf 50 V	.07
.22 uf 25 V	.07
.47 uf 63 V	.07
1 uf 6.3 V	.07
1 uf 50 V	.07
1 uf 63 V	.07
2 uf 10 V	.07
2.2 uf 16 V	.07
2.2 uf 35 V	.07
2.2 uf 50 V	.07
3 uf 300 V	.12
3.3 uf 16 V	.07
3.3 uf 25 V	.07
3.3 uf 50 V	.07
4.7 uf 10 V	.07
4.7 uf 25 V	.07
4.7 uf 250 V	.12
4.7 uf 315 V	.12
5 uf 3 V	.07
6.8 uf 10 V	.07
10 uf 16 V	.07
10 uf 25 V	.07
10 uf 120 V	.12
22 uf 25 V	.10
22 uf 50 V	.10
22 uf 120 V	.12
22 uf 250 V	.19
25 uf 25 V	.10
25 uf 63 V	.12
25 uf 300 v	.15
33 uf 6.3 V	.07
33 uf 10 V	.07
33 uf 25 V	.07
33 uf 50 V	.12
33 uf 160 V	.19
33 uf 200 V	.19
33 uf 250 V	.19
47 uf 6.3 V	.07
47 uf 10 V	.09
47 uf 16 V	.09
47 uf 25 V	.10
47 uf 63 V	.12
80 uf 10 V	.09
80 uf 16 V	.12
100 uf 3 V	.07
100 uf 6.3 V	.07
100 uf 10 V	.09
100 uf 16 V	.12
100 uf 35 V	.15
100 uf 63 V	.18
150 uf 3.15 V	.07
200 uf 6.3 V	.12
200 uf 10 V	.12
200 uf 12 V	.12
200 uf 15 V	.18
220 uf 6.3 V	.09
220 uf 10 V	.12
220 uf 16 V	.14
220 uf 25 V	.15
220 uf 35 V	.19
220 uf 50 V	.23
220 uf 63 V	.23
330 uf 10 V	.15
470 uf 16 V	.19
470 uf 25 V	.19
470 uf 35 V	.31
500 uf 10 V	.15
640 uf 16 V	.19
1000 uf 6.3 V	.19
1000 uf 10 V	.19
1000 uf 16 V	.22
1000 uf 18 V	.22
1000 uf 25 V	.30
1000 uf 35 V	.30
2200 uf 10 V	.30
2500 uf 16 V	.60

RG/RD/RP LUG TERMINAL

1000 uf 63 V	1.40
1000 uf 100 V	1.60
1500 uf 35 V	.60
2500 uf 35 V	1.10
2500 uf 63 V	1.60
2500 uf 80 V	1.75
3300 uf 50 V	1.60
3300 uf 75 V	2.70
4700 uf 35 V	1.20
4700 uf 100 V	4.20
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Caution!

The entire circuit is at mains potential (including the tube) and, if you don't want to fry yourself – or be responsible for somebody else accidentally doing likewise – it is essential that the case be securely earthed. The power cord must be arranged and secured strictly as shown in the diagrams. Use proper 240 Vac rated wiring (23-0076 PVC insulated) for all connections. For safety's sake, a perspex cover is bolted over the open end of the reflector.

Assemble the printed circuit board according to the overlay, noting the polarity of the diodes. If two strobe tubes are to be used, include the additional 820 ohm, 10 watt resistor as shown.

Plastic standoffs must be used to mount the pc board. These standoffs decrease the chance of a short to the metal case. They are necessary secondly because the trigger transformer develops 4 kV pulses which could possibly develop arcs across the pc board should metal standoffs be used.

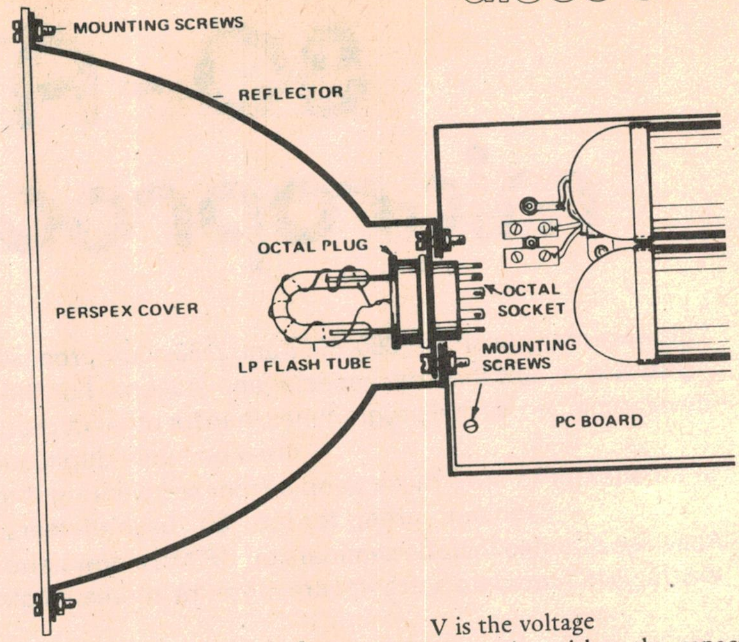
The strobe tube itself is not a critical component. Two types are commonly available. The type MFT1210 from Circuit Components of Bexley NSW is one such unit. Another is that advertised by Dick Smith, (catalogue No. S-3882).

Neither of these tubes includes a trigger electrode, so one must be attached. This is simply made by winding a length of 22 gauge (or some gauge thereabouts) tinned copper wire around the glass and taking it down to a spare pin in the octal base on which the strobe tube is mounted. The diagram shows how one or two tubes, together with their trigger electrodes, are mounted in the octal plug.

When you have the assembly complete make sure all components are securely mounted and there are no short circuits – or any possible – and **RE-CHECK THE EARTH CONNECTION.**

The smoke test

Perhaps that's a little too strong! Nevertheless, once you have the unit assembled and carefully checked, set the speed potentiometer to minimum flash rate (fully anticlockwise), plug in and switch on. If all is well, the strobe should flash about once per second or a little faster, depending on which value pot. is installed. Advancing the control should increase the flash rate.



How the strobe tube works

For those not familiar with a strobe tube and the way it works, the following explanation should, er . . . throw some light on the subject.

A strobe tube is a simple tube of glass, sealed at the ends and bent into a convenient shape, evacuated and then filled with a tiny amount of one of the rare gasses – in this case Xenon. Small metal electrodes are sealed in the ends of the tube, projecting into the interior. A third, 'trigger' electrode is attached in some manner around the outside of the tube, though not completely covering it. Some 300 to 500 volts dc is applied between the two end electrodes, generally from a storage capacitor, but the resistance of the gas is very high at this stage and negligible current will flow. When a very high voltage pulse, about 4 kV, is applied to the trigger electrode, the gas inside the tube ionises ('Breaks down'), its resistance falling quickly to a very low value. The storage capacitor discharges through the tube and an enormous current flows – amps of it! – the voltage across the electrodes falling in about 100 microseconds to a value below that necessary to maintain the gas ionised. When the gas ionises it emits an intense burst of light, extinguishing when the discharge ceases.

The amount of light produced during each flash is dependant on the value of the discharge capacitor and the voltage across it. For those interested, the formula for the energy of the discharge is:–

$E = \frac{1}{2}CV^2$

where E is the discharge energy, in joules
C is the capacitance in Farads
V is the voltage

Increasing either the capacitance or the voltage will increase the energy of the discharge, and hence the light output. However, as the output is increased, tube life falls off dramatically.

A better way to obtain more light output is to use two tubes. Separate storage capacitors are necessary as each tube varies with regard to discharge characteristics. If two tubes are simply connected in parallel, whichever commences to discharge first – even though it may only be microseconds earlier – will prevent the other tube from firing.

In the circuit used for this strobe unit, two 6 uF capacitors are used in parallel for the storage capacitor. For two tubes, another two capacitors are used. The same trigger transformer may be used to trigger both tubes in a twin-tube model.

For small rooms or total darkness, the light output of a single tube unit will be more than adequate. For larger rooms, halls etc, two tubes will be necessary. ●

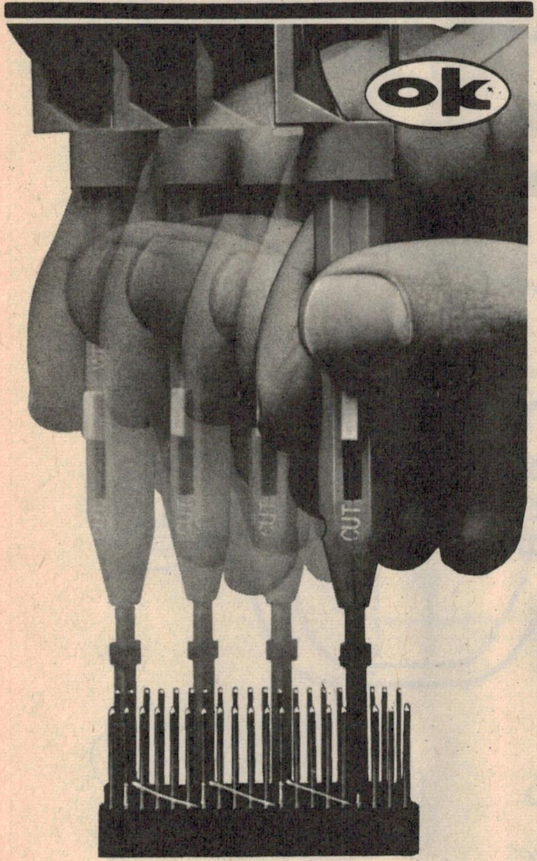
WARNING

Repetitive pulses of light – especially around nine flashes per second – may cause epileptics to have convulsive seizures.

Those prone to grand mal, or psychomotor attacks should avoid areas where strobe lights are operating. In fact, most people will suffer nausea or headaches after long exposure to a strobe.

In the event of an attack whilst the strobe light is operating, it must be turned off immediately.

NEW!



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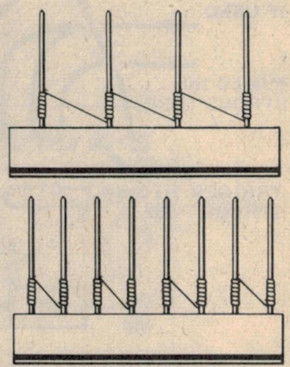
REPLACEMENT ROLL OF WIRE 50 FT.	BLUE WHITE YELLOW RED	R-JW-B R-JW-W R-JW-Y R-JW-R



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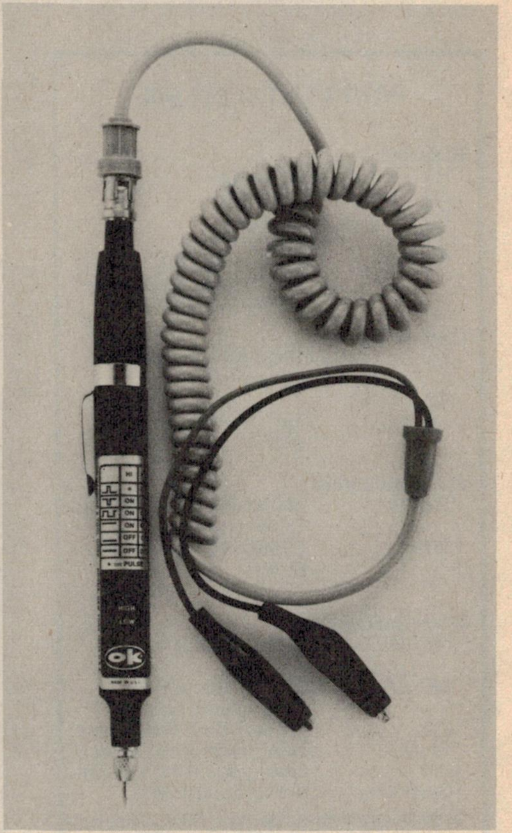

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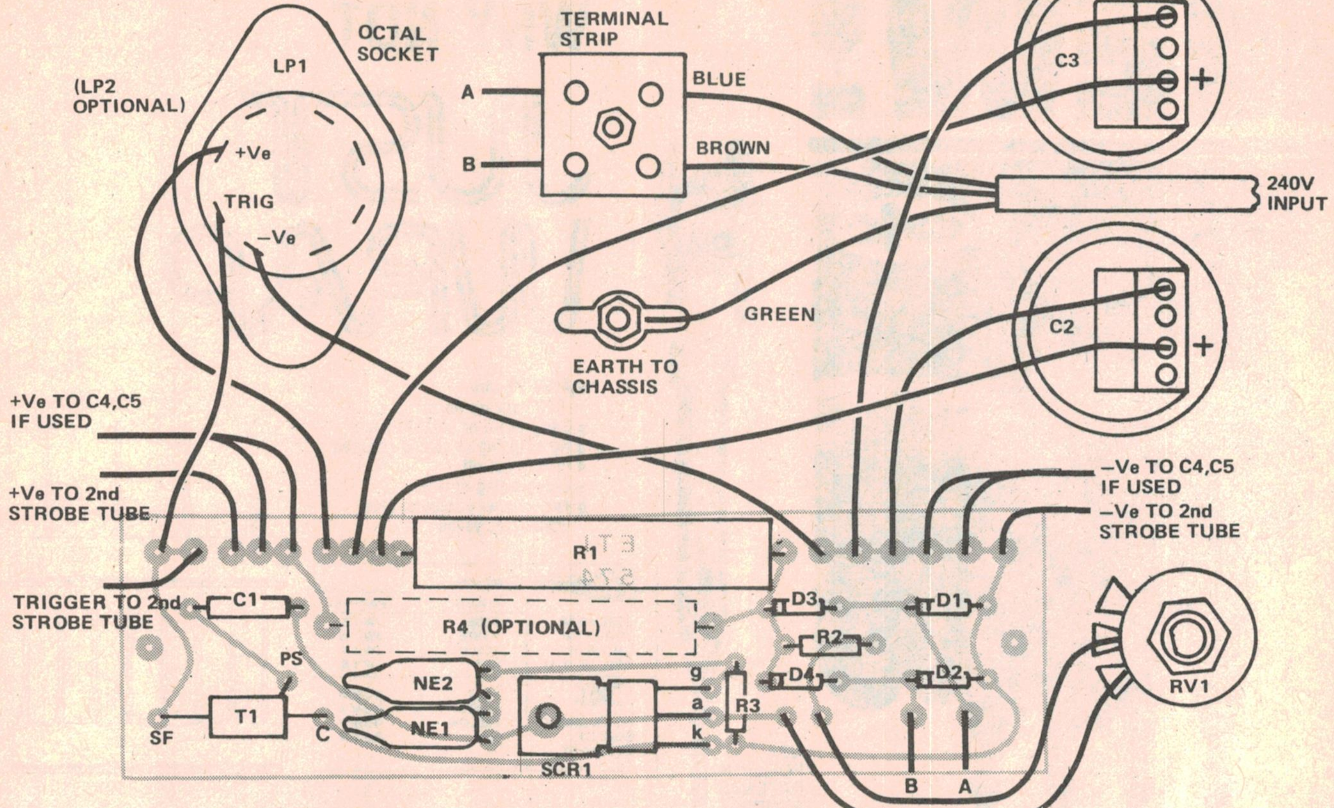
VIC: Radio Parts, 329-7888. Stewart Electronics, 543-3733. Arlin Instruments, 569-6984. Ellistronics, 602-3282
S. AUST: Protronics, 212-3111.
W. AUST: Reserve Electronics, 328-3116.
QLD: Wilber Sales, 391-5136.

The pc artwork is on page 83.



PARTS LIST – ETI 574

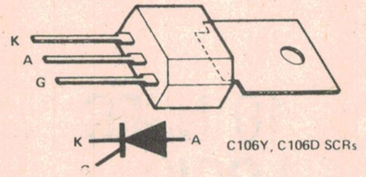
Resistors
R1 . . . . . . .820R 10W
R2 . . . . . . .470k ½W
R3 . . . . . . .1 meg
R4*. 820R 10W
RV1 . . . . . .2M or 5M linear potentiometer with double pole switch (see text)

Capacitors
C1. . . . . . . .100n 400Volt polycarbonite
C2,C3,C4*, C5* . . . . . 6μF 240Vac capacitor (RIFA type PHN)

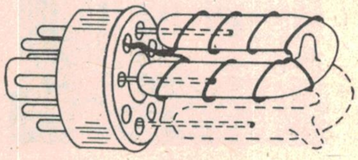
Semiconductors
D1-D4 . . . . .EM4004,EM404, A14A or sim.
SCR1. . . . . .C106D,BT100A 500R, or sim.

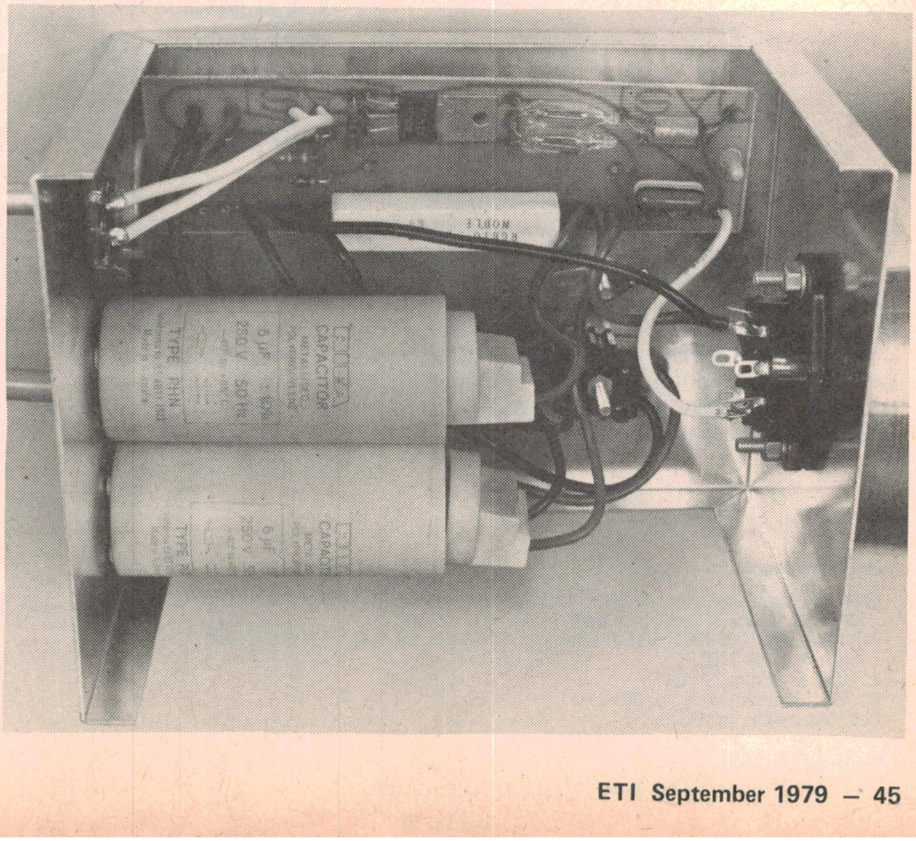
Miscellaneous
NE1,NE2. . . .neon indicator tube GE - NE2
LP1,LP2* . . .Strobe tube, Circuit Components type MFT 1210 or Dick Smith type.
T1. . . . . . . .pulse transformer to suit tube type TR4KN or sim.
Octal Plug . . .McMurdo L8USR1
Octal Socket McMurdo type RT8, reflector, metal box 145 mm x 115 mm x 90 mm, perspex cover, hinge, magnetic catch, power cable, ETI 574 pc board.

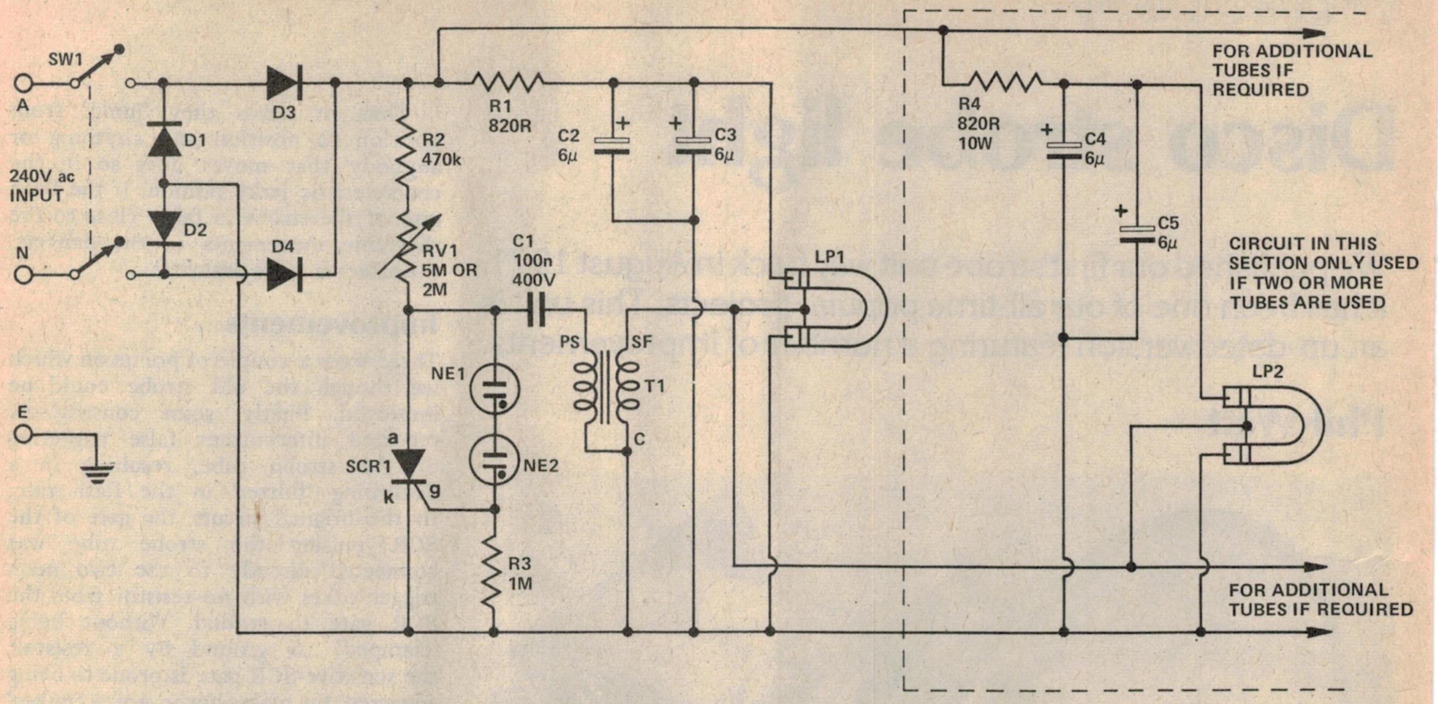
*Components marked with an asterisk are only used for two tubes.



C106Y, C106D SCRs







HOW IT WORKS – ETI 574

The principle of operation of the strobe tube is discussed in the general text, so here we'll concentrate on the overall circuit.

The mains voltage is rectified by a diode bridge circuit formed by D1, D2, D3 and D4. Since there is no capacitor directly across the dc output of the bridge rectifier, the output consists of a series of half-wave pulses at a frequency of 100 Hz (i.e.: twice the mains frequency). The storage capacitors, C2 and C3 (plus C4, C5 etc if extra tubes are added) are charged from the bridge rectifier output via R1 (R3 etc for extra tubes). They will charge to the peak value of the rectifier output, about 340-350 volts. (That is, 1.414 times the mains voltage: 240 x 1.414 = 339 volts).

The resistor in series with the storage capacitors (R1, R3) limits the peak charging current to prevent damage to the rectifier diodes and also serves to isolate the strobe tube from the mains.

The two neon 'trigger' lamps, NE1 and NE2, each have a 'striking potential' of around 120 volts. That is, the neon gas inside will ionise, ('break down') and the lamp 'fires', conducting current very suddenly when this striking voltage is reached or exceeded.

Now, C1 is charged from the bridge rectifier output via R2 and RV1. As the voltage across C1 rises it will eventually reach the striking voltage of the two neons. As these are in series, the voltage across C1 must reach about 240 volts before they strike. When this occurs, a pulse of current will flow into the gate of SCR1, causing it to conduct. This effectively places C1 across the primary of T1 as the anode of SCR1 is then connected to earth for all intents and purposes. C1 will then rapidly discharge, the resulting pulse in the primary of T1 being transformed to about 4 kV at the secondary.

As the secondary of T1 is connected to the trigger electrode of the strobe tube, this will 'break down' and emit a bright flash of light when the trigger electrode receives the 4 kV pulse from T1.

After C1 has discharged, NE1 and NE2 will extinguish, SCR1 will turn off and C1 will commence to charge again. The whole cycle will then be repeated.

Varying the rate at which C1 charges, and thus the amount of time it takes to charge C1 to about 240 volts, will vary the time between flashes. Thus RV1, a 2 M or 5 M potentiometer, serves as a 'flash speed' control. Increasing the resistance of RV1, increases the time it takes C1 to charge to 240 volts, increasing the time between flashes — which decreases the flash rate.

The storage capacitors, C2 and C3 (with one tube), discharge when the strobe tube fires, recharging between successive flashes.

When two (or more) tubes are used, each must have a separate storage capacitor (made up of two capacitors here, for convenience) and limiting resistor, otherwise — as explained in the text — the first tube to fire in a parallel-connected arrangement would prohibit the other tube(s) from firing.

The resistor between the gate of SCR1 and ground, R4, prevents spurious triggering of SCR1.

used. The capacitors specified have a threaded mounting bolt protruding from the base, making mounting a simple matter. Also mounted on this end of the box are the flash speed potentiometer and the power switch. The power cord passes through the panel also, being secured by a clamp-type grommet. A two-pole mains switch must be used and can be either a separate switch or integral with the flash speed potentiometer. Note that a switch-pot. has been specified in the parts list.

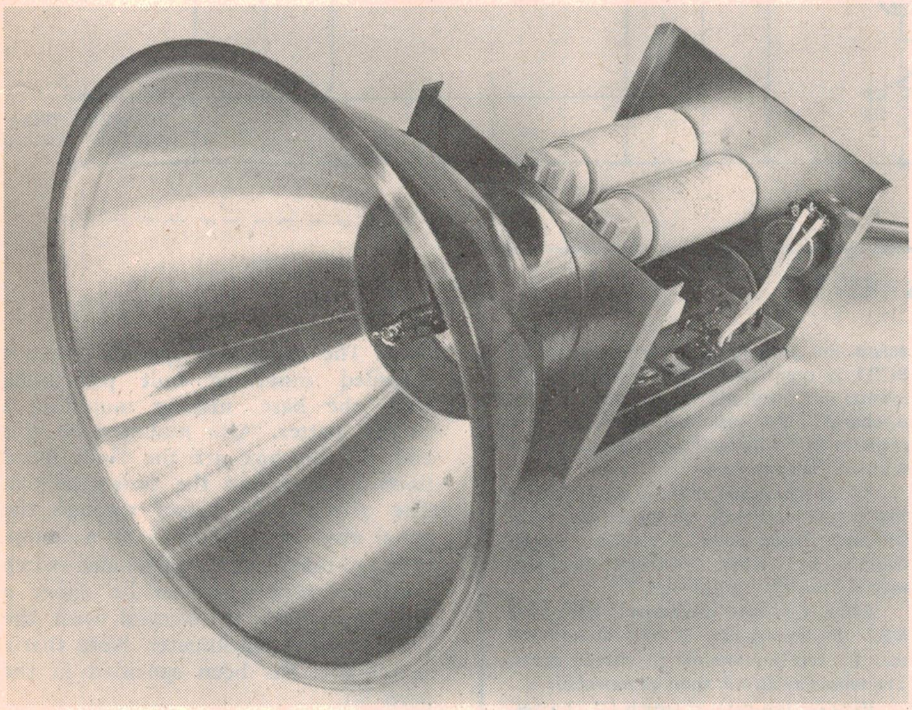
If one strobe tube is used, only two capacitors will be required. These should be mounted, so that two more may be mounted at a later stage if another strobe tube is added. The potentiometer may have a value of either 5M or 2M, depending on which is the more readily available. The 5M pot. will give a speed from about one flash per second to about 20 flashes per second. The slowest speed is somewhat too slow for most applications, but this matters little as the desired flash rate will be within the general speed range in any case. The 2M pot. gives a range of about two or three flashes per second up to about 20 flashes, as before.

Whatever you do, do not omit the plastic cover over the front of the reflector. This is to prevent accidental contact with the flash tube and the lethal voltages present.

Disco strobe light

We published our first strobe unit way back in August 1971. It has been one of our all-time popular projects. This unit is an up-dated version featuring a number of improvements.

Phil Wait



STROBE LIGHTS are very popular as lighting effects devices at parties and discos. Emitting a series of bright flashes of light several times per second, the movement of dancers takes on a jerky 'stop-motion' effect. Used in conjunction with coloured 'light show' effects units that vary the colour and intensity of a bank of lights, the overall effect achieved can be quite stunning.

We first published a strobe unit for this application back in August 1971. That was the ETI 505 High Power Strobe. It has been by far the most popular project we have ever described. The ETI 505 was still available as a kit – and a steady seller by all accounts – quite recently.

When the demand for a new strobe became apparent earlier this year, we sat down and took a long hard look at the original design. But despite all the revolutionary technology that has appeared since then, there was no way we could see of significantly altering the device to any advantage. That original design was just about the simplest, least expensive and most effective for a strobe that could be devised. However, experience over the years showed up a number of minor shortcomings and we have modified the circuit to eliminate these – and this Disco Strobe is the result.

The effect

How does a strobe produce the 'stop-motion' effect? Quite simply, really. At each flash of light, in a darkened room, you will see everybody in the position they are in at the instant of the flash. During the short interval before the next flash, they will have moved and you will see them in a slightly different position, and so on. Thus, it seems they 'jump' from position to position and anything or anybody that moves does so in the characteristic jerky fashion. If the flash rate of the strobe is fairly close to the rhythmic movements of the dancers, the effect is quite dramatic.

Improvements

There were a couple of points on which we though the old strobe could be improved. Firstly, some constructors reported intermittent false triggering of the strobe tube, resulting in a disturbing 'flutter' in the flash rate. In the original circuit, the gate of the SCR pulsing the strobe tube was connected directly to the two neon trigger tubes with no resistor from the SCR gate to ground. Without being 'clamped' to ground by a resistor, the sensitive SCR gate is prone to being triggered by mains-borne noise 'spikes' capacitively coupled to it via the neon tube or adjacent circuitry. This has been corrected in the current project.

The second point was more of a construction problem. The capacitor charging circuit and the flash timing circuit on the original strobe were each powered by separate half-wave rectifiers. Now that appears like a full-wave bridge rectifier with the bridge not completed. Many constructors saw this and immediately took it to be a mistake – so they 'put it right' by connecting the cathodes of D3 and D4 in that circuit. The result was always disastrous! Our sympathies to those who were caught.

To avoid this occurring again we decided to use a conventional bridge rectifier to power the complete circuitry.

Construction

Carefully examine the photographs and the construction diagrams. Assembly is quite straightforward and little difficulty should be experienced. Care must be taken with the wiring though, as the unit operates directly from the mains.

The electronics is all mounted in a 145 x 115 x 90 mm aluminium box. A 180 mm diameter spun aluminium reflector is mounted on one end, the strobe tube(s) being mounted inside this by a plug and socket arrangement. An octal valve socket is used, its mounting screws being used to secure the reflector to the box.

At the opposite end of the box, the discharge capacitors are mounted, two or four being used depending on whether one or two strobe tubes are ▶

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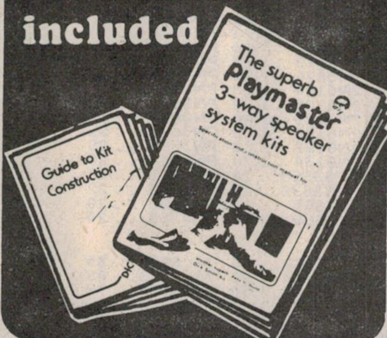

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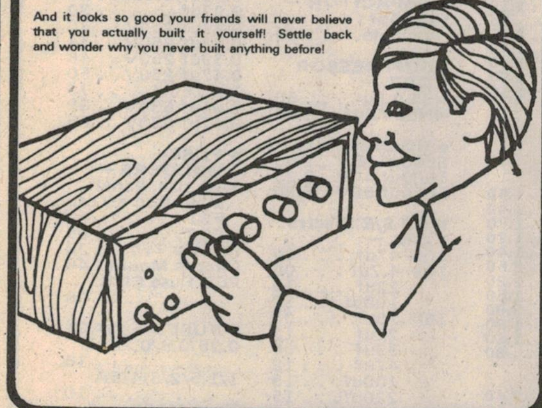

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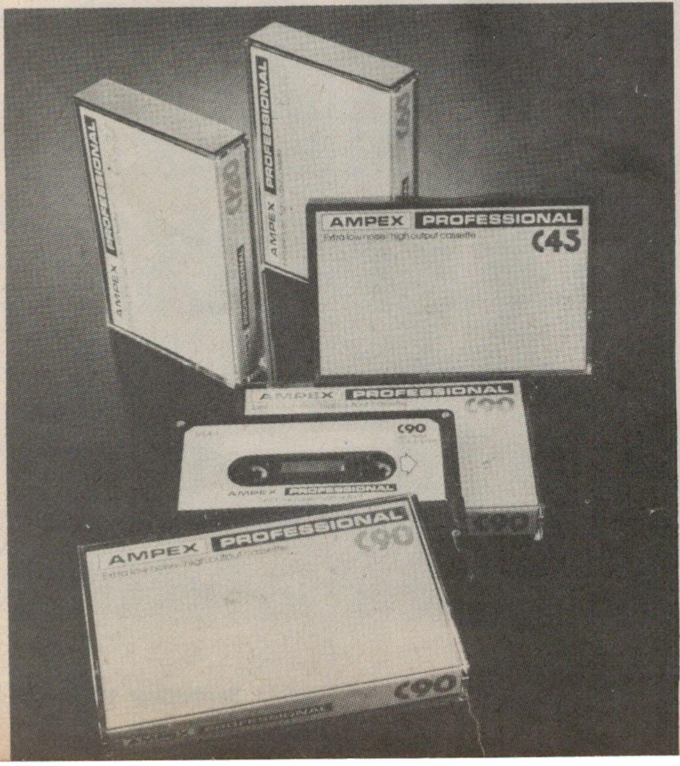
The shell, and its internal components, are precision products designed for the highest mechanical reliability. The pressure pad system is a felt/beryllium copper spring assembly. Rotating guide rollers run on lubricated stainless steel pins.

A special formulation in the interior top and bottom liners reduces tape edge friction and minimises possible wow and flutter. The cushioning effect created by the liners helps to reduce mechanical noise to a practically inaudible level. The convex shape of the liners causes a spring-like action which controls tape torque and tape alignment and helps in forming a uniform tape pack for smooth, jam-free operation.

The cassette shells are assembled with five screws to maintain precise internal dimensional uniformity. The shell may be dis-assembled for editing or splicing if required.

Windows, which allow visual inspection of the tape packs, are made of solid transparent polystyrene to protect the tape from dust.



CHARACTERISTICS	SPECIFICATION
CASSETTE TAPE SYSTEM	
PLASTIC SHELL	
Dimensions:	Manufactured in conformance to Philips Dimensional Standards.
Materials of Construction:	High heat, medium impact polystyrene.
Torque Control Liners:	Graphite coated, preotensioned polyester.
Pressure Pad Assembly:	Felt/Beryllium copper spring.
Magnetic Shielding:	Full-width steel.
Closure Method:	5-screw assembly.
Tape position Windows:	Rigid polystyrene. Welded.
Tape Guide System:	Rotating guide rollers operating on lubricating stainless steel pins.
SYSTEM PERFORMANCE	
Rotating Torque:	Less than 25gm/cm without hold-back.
Wow and Flutter:	Less than 0.10% DIN weighted.

INTRINSIC MAGENTIC OXIDE PROPERTIES		
Coercivity (Hci) in oersteds	290	290
Retentivity (Brs) in gauss	1100	1100
Erasure (1000 oersted field) in db	–60	–60
PHYSICAL PROPERTIES		
Base film thickness in mils	0.50	0.30
Base film type	Tensilized polyester	Tensilized polyester
Oxide coating thickness in mils	0.20	0.17
Total thickness in mils	0.70	0.47

This may give you the first, real musical experience you've ever had at home!

Congratulations! You've decided you need something better in music than your old radio can offer. Fine.
But let's suggest a mistake-proof way of doing it.
A beautifully engineered Kenwood hi-fi component system.
We said mistake-proof, because not all such systems are made the same way. Some of them look OK, but after a couple of months you'll wish you'd been more consumer-wise.
Expertise is the name of the game. Which is why you can currently find the Kenwood name on some of the audio world's most exciting hi-fi products.
The same engineering skill has gone into the making of the component system you see here.
If you're the kind of person that demands quality, listen carefully to what the Kenwood system offers.
Then throw away that old radio—and start living!

KA-405	Stereo Integrated Amplifier
KT-413	Auto-Sequential Tuning FM/AM Stereo Tuner
KX-550	Cassette Deck With Dolby* Noise Reduction
KD-1500	Auto-Cut Belt-Drive Turntable
LS-60	Speaker System
SRC-95	Functional, Elegant Mounting Rack

*Trademark of Dolby Laboratories, Inc.

KENWOOD

For information, please write to: ET-SECTION.
TRIO-KENWOOD CORPORATION 6-17, 3-chome, Aobadai, Meguro-ku, Tokyo, Japan.
TRIO-KENWOOD (AUSTRALIA) PTY. LTD. 30 Whiting St., Artarmon, N.S.W. 2064, Australia Tel: 439-4322

Louis A Challis and Associates Pty Ltd

MEASURED PERFORMANCE OF THE

DICK SMITH STEREO CASSETTE DECK, MODEL A-3500,

SERIAL NO. BBFA 12129

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

TAPE	DOLBY	Lower -3dB Point	Maximum Point	Upper -3dB Point
Maxell UDXL I	Out	<20Hz	+0.5dB (140Hz)	15.5kHz
	In	<20Hz	+1.0dB (2kHz)	14.5kHz
Sony FeCr	Out	<20Hz	+1.0dB (150Hz)	12kHz
BASF Chrom. Dioxid. Super	Out	<20Hz	+1.5dB (140Hz)	15kHz

SPEED ACCURACY:
0.35% Fast

WOW & FLUTTER:
Wow: 0.2% p-p
Flutter: 0.16% unweighted RMS
0.1% weighted RMS

TOTAL HARMONIC DISTORTION:
(Using Maxell UDXL I Tape) at 0VU:

	100Hz	1kHz	6.3kHz
2nd	-57.0dB	-53.9dB	-46.9dB
3rd	-47.4dB	-45.9dB	-
4th	-58.3dB	-60.7dB	-
5th	-53.7dB	-60.8dB	-
THD	0.51%	0.56%	0.45%

TOTAL HARMONIC DISTORTION:
(Using Maxell UDXL I Tape) at -6VU:

	100Hz	1kHz	6.3kHz
2nd	-51.4dB	-53.6dB	-53.0dB
3rd	-56.4dB	-50.8dB	-
4th	-61.1dB	-	-
5th	-68.3dB	-	-
THD	0.32%	0.36%	0.22%

NOISE: (re 0VU) (Using Maxell UDXL I Tape)

Dolby Out	-49dB(Lin)	-51dB(A)
Dolby In	-54dB(Lin)	-60dB(A)

MAXIMUM INPUT LEVEL:
(for 3% third harmonic distortion at 1kHz) +7VU

ERASURE RATIO:
(for 1kHz signal recorded at 0VU) >78dB

comparable long term stability as do ferrite heads or sendust heads and this could be a limitation.

Having satisfied ourselves as to what the machine can do objectively and how it is constructed, we proceeded with our subjective evaluation. We used both commercial and pre-recorded cassettes as well as cassettes that we have previously produced specifically for this purpose.

We immediately noted that the ejection mode by which the cassette well opens up is positive, and if anything, a little too positive. The internal well is constructed from a clear plastic material. It would really benefit from a rubber impact pad within the structure to protect it from premature fracture or inadvertent failure. All the other controls worked well and the unit presented absolutely no problems in use.

The direct record to replay characteristics of the machine are unquestionably excellent and the fidelity on replay of material recorded on the machine, as well as the general lack of distortion, equalled machines selling at up to three times the price.

By contrast, the direct play performance on pre-recorded material fell short of this high standard but was still reasonable. The reason for this difference in performance is easily explained. Many manufacturers take a lot of care and trouble to equalise the record/replay frequency response so that a tape recorded on the machine and then replayed, provides the best possible bandwidth. It is only generally in a more expensive machine where the manufacturer also bothers to go through a prior step to equalise the replay characteristics to match the Philips standards. Only if this is done, is replay in the critical 8 kHz to 15 kHz region equally as good. Obviously such care and attention in design involves additional cost and thus it is only in the more expensive machines, although we acknowledge not all of them, that this dual feature is provided.

Summary

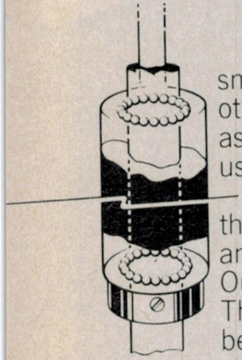
Our overall evaluation of the A-3500 cassette deck is that it is an unusually good machine considering its price. It has a record to replay frequency performance which is particularly good and a replay performance which is fully acceptable. At a current selling price of $159 it must be one of the best buys, if not the best buy, on the market at the moment. ●

DICK SMITH STEREO CASSETTE DECK WITH DOLBY, MODEL A-3500, SERIAL NO. BBFA 12129
(Complete with one DIN lead)

Dimensions: 400mm wide x 140mm high x 320mm deep
Weight: 4kg Price: $159.00.
Manufactured in Japan for Dick Smith Electronics, Sydney.

Take the Pioneer to pieces to find what makes it unique.

On the surface, most turntables appear to be very much the same.
That's why we suggest you should look at the PL-560 in more depth.

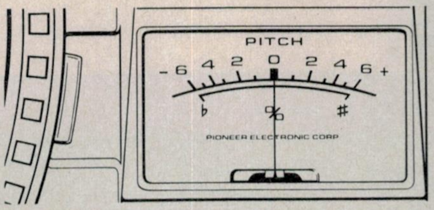


First, take our arm.

Our tone arm moves smoothly and silently. Where other makes rely on as few as 3 ball bearings, Pioneer uses 40.
Some turntables mount their arms on cheap plastic and piano wire that vibrates. Ours floats on pivot bearings. This explains why we sound better.

Accuracy at every turn.

By using our own Quartz locked DC Hall motor just to power the platter, Pioneer give you accuracy and reliability for the life of the turntable.
The Hall motor assures the PL-560 turns silently. Any vibration or radiation is also eliminated.
Moreover, if you keep delving, every piece of Pioneer engineering you reveal will be backed by precision componentry.



A feature that's obvious.

While you're finding out how the PL-560 compares on the inside, look up for a minute. Note the Analogue Pitch display meter next to our strobe.
Use it expressly for tuning your music by 6% up or down.

A second motor. Just for moving our arm.

Many automatic turntables don't hesitate to put strain on one motor by asking it to perform extra functions.
However, Pioneer prefer to use a Warren gear motor to move their tone arm, which in turn takes the load off the primary drive.
The extra power gained makes "Arm drag" on the PL-560 non-existent.
At this point, please continue the examination at your own speed. You'll find we're much more turntable than we appear to be.
All the turntables illustrated offer the excellence synonymous with Pioneer.

PL-560 $559.00*

The third rule of sound quality: Phase Linear means power...and vice versa.

Phase Linear are the people who started it all. Real high power, that is, to give you more head room and the reserve to prevent clipping.

And Phase Linear are still far in advance of the late comers, who saw the light and joined the race. But it's really no contest, when you recognise that really high power is Phase Linear's specialty, and has been for many years.

All high power.

As a matter of fact, our smallest model, the Phase Linear 200 Series Two, pumps out a massive 120 watts each channel, and our latest, the Phase Linear Dual 500...why, it produces a staggering 505 watts per channel with no more than 0.09% total harmonic distortion!

Designed to handle speaker impedances down to 2 ohms, the Dual 500 easily adapts to rugged professional use or demanding home applications. A self-contained, thermally activated cooling system, combined with instantaneous LED display incorporating built-in output clipping indication, allows for precise power control. Electronic energy limiters and independent fusing of the power supply prevent the possibility of damaging overloads.

For every system.

This same dedication to exceptional performance is found in each of the Series Two power amplifiers, one of which is exactly right for your system, and your pocket.

See the complete Phase Linear range at your audio specialists, or write for complete information.

Distributed in Australia by Acoustic Monitor Co Pty Ltd (Member of the Thomas & Coffey Group), 12-18 Gould Street, Enfield, NSW 2136. Phone (02) 642-7888. Telex: 26778. Cables: "Tomcoffy" Sydney.

	Dual 500	700-Series Two	400-Series Two	200-Series Two
OUTPUT POWER PER CHANNEL*	505 WATTS	360 WATTS	210 WATTS	120 WATTS
Intermodulation Distortion (60Hz: 7kHz = 4:1)	0.09% MAX	0.09% MAX	0.09% MAX	0.09% MAX
Signal to Noise Ratio (IHF "A")	110dB	110dB	110dB	110dB
Residual Noise (IHF "A")	120uV	120uV	120uV	120uV
Cooling Fan	YES	OPTIONAL	OPTIONAL	OPTIONAL

Optional Accessories: 1) Standard E.I.A. rack mount configuration. 2) Solid Oak or Walnut side panels.

*Output Power Minimum RMS per channel into 8 ohms from 20Hz-20kHz with no more than 0.09% THD.

Phase Linear®

THE POWERFUL DIFFERENCE

SMA/AMB

Why most other record cleaners are victims of their own design.

THE SONIC BROOM™

RECORD CLEANING SYSTEM

Look at almost every record cleaning brush on the market. You'll see a pad completely covered with closely packed fibers sticking out, intended to trap surface debris as they rub across the record surface.

Now look at the new Audio-Technica Sonic Broom cleaner. Lots of closely-packed fibers alright, but we skip a whole row, every fourth row. Which may make a funny looking pad, but a superior cleaner.

There are several reasons for our effectiveness: By skipping every fourth row, the Sonic Broom pad gets deeper into each groove without excessive pressure on the record surface. If we had more tufts—like most of the others—the Sonic Broom fibers might do a great job of cleaning the surface *between* the grooves, but never get to the very bottom where foreign matter can build up and destroy good sound.

Our varied tuft spacing also permits dislodged particles to migrate further from the tips of the cleaner fibers during cleaning. Without those gaps, the loosened particles would stay right at the ends of the fibers where they are easily redeposited somewhere else on the record. And you want to *remove* dust...not just move it around.

The differences don't stop with our fibers. The shape of the Sonic Broom pad has been carefully designed to make it easy to hold, easy to use correctly. The curve insures that just the right amount of cleaning area is in contact with the record at any time for maximum effectiveness. And the rigid backing, unlike soft pads, helps insure that the fibers don't simply collapse under pressure but are directed deep into every groove.

And how well does the Sonic Broom system clean, once the fibers reach the bottom of the groove? Very well indeed, since each tiny fiber is so small (about 6 microns or 0.00025" in diameter) that dozens can work side-by-side, contacting the entire groove wall surface. Even the smallest dust particles can't escape the repeated brushings.

Australian distributor:
MAURICE CHAPMAN AUST. P/L.
44 Dickson Ave, Artarmon. 2064. Tel: 438-3111.

audio-technica
INNOVATION □ PRECISION □ INTEGRITY

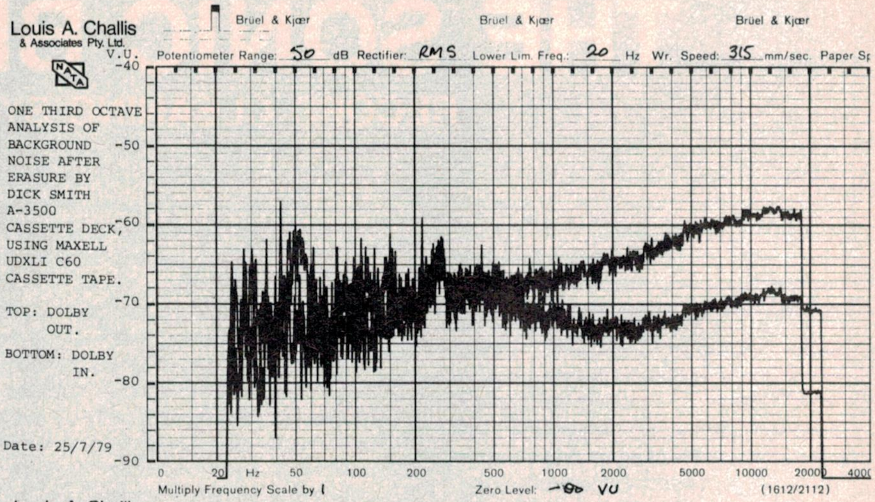
State distributors: Adelaide 272-8954 • Melbourne 818-1730 • Brisbane 44-7566 • Perth 446-5679

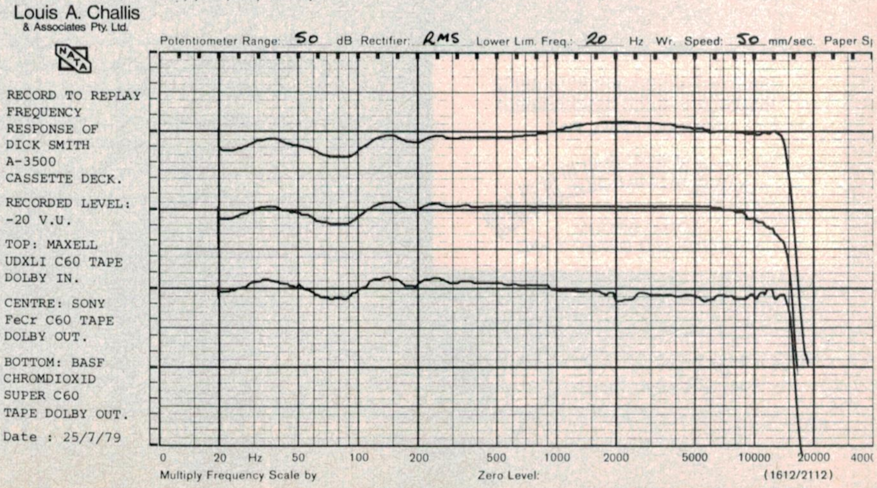
We were not satisfied with the objective tests and opened up the unit to see what it contained. The first thing that struck our eyes was the large amount of empty space in a cabinet which could have taken much more electronics. The unit features three printed circuits which are all located upside down on stand off mounts. These boards surprisingly feature a large number of wiring inter-connections and components tacked onto the back.

Notwithstanding, the boards are well made, coded with inter-connection pin numbers, coated to preclude premature corrosion and neatly wired, even if the wiring is more extensive than we are used to seeing. The designers have made extensive use of ribbon cable connections for direct colour coding and the unit definitely does meet the Australian Electrical Authorities' design rules. The transport mechanism is very simple and if anything is the only area where we were concerned that the long term performance may not equal the same high standards indicated in our objective testing.

The mechanism is given a reasonable degree of protection but a more exhaustive testing would be required to determine how well it will perform. The record head has a permalloy core whilst the erase head has a ferrite core. Permalloy heads do not necessarily offer

(continued on page 129) ▶





SOUND review

Dick Smith model A-3500 stereo cassette deck

A remarkable performance from such an inexpensive deck "... one of the best buys, if not the best buy, on the market at the moment."

FATE IS STRANGE. Our first contact with the Dick Smith A-3500 Cassette Deck was to see it featured on the front page of Dick Smith's latest leaflet advertising a *"genuine warehouse moving sale"*. This particular unit is shown as being marked down from $199 to $159 and is claimed as a *"really fantastic bargain"*. The bottom line of the ad. claims that *"this is an extremely high quality cassette deck you will be proud to own"*.

We had hardly put down the leaflet, when an A-3500 landed in our office for testing and evaluation!

The particular unit we received came in the original packing and appears to be typical of the units that you can buy off the shelf in any Dick Smith shop.

Features

The first and most significant advantage of this deck is that it is a front-loading, and not a top-loading, cassette deck. Most people prefer the former.

The controls are all clearly labelled and the satin brushed aluminium is surmounted by a high quality black stencilling which we couldn't rub off. The main operational controls for the cassette drive are by long piano-lever keys. Whilst these keys are reasonably positive, they lack the smooth feeling that some other decks (which are admittedly more expensive) provide.

The unit sensibly provides bias and equalisation for ferrichrome, normal gammaferric oxide and chromium dioxide tapes. It incorporates a Dolby on/off switch and an input selector for dynamic microphone or line inputs. The only other controls are concentrically ganged record volume potentiometers. Regrettably, the unit does not contain an output volume control or a headphone jack (which would add to the cost). The unit does have two modest but reasonable VU meters which flank a red recording bezel indicator light.

The back of the cabinet features two pairs of RCA coaxial input sockets, together with a DIN input/output socket. One feature we didn't like is the fuse location. It is mounted internally on the main rectifier board.

Whilst the main chassis and front panel supporting brackets are all galvanised steel construction, the external cabinet is plastic coated plywood and not steel, as is the practice with many other low cost decks. Personally we prefer a plywood cabinet and this one is reasonably well made and finished neatly.

Evaluation

It was with some trepidation that we started to carry out our objective laboratory tests for one could reasonably take the attitude that any deck that sells for $159 must have a performance that matches.

The first series of tests conducted were to determine the frequency response of the unit which the instrumentation manual conservatively claims is 40Hz to 12.5kHz.

The replay frequency response of the deck was better than stated at the bottom end but not quite as good at the top end. The replay reference tapes we use are better than average so that other pre-recorded tapes would fair no better.

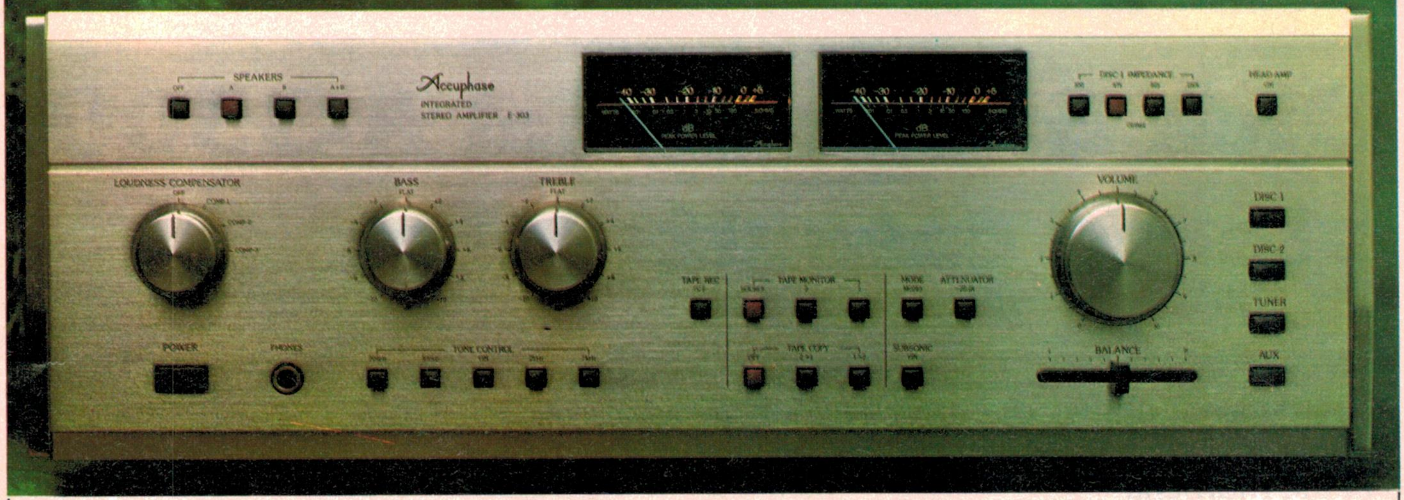
On record to replay evaluation with Maxell UDXL I, Sony Ferrichrome and BASF chromium dioxide, the −3 dB performance extended typically from below 20 Hz to 15.5 kHz, from below 20 Hz to 12 kHz and from below 20 Hz to 15 kHz respectively.

These performances are particularly good and even better when one takes into account the price of the machine.

If the frequency response was good, then the other parameters are equally important. The speed accuracy was 0.35 "fast" which is acceptable. The wow was a modest 0.2% peak to peak and the flutter 0.1% weighted RMS. Even the total harmonic distortion figures at 0 VU were typically 0.56% or lower; and at −6 VU a very commendable 0.36% or lower. The noise figures were equally good, being 51 dB (A) with Dolby out and 61 dB (A) with Dolby in (re 0 VU), the maximum input level for 3% THD was a very healthy +7 VU. The erase ratio for 1 kHz at 0 VU was −78 dB.

Taken all in all, the measured objective tests indicate that this is a particularly good unit.

THE NEW ACCUPHASE E303 MOSFET AMPLIFIER



After intensive research and development, Accuphase proudly announce the release of the most advanced amplifier ever to be released in Australia — the new E303 Power MOSFET Integrated Amplifier.

The E303 is the result of many years of amplifier design experience. The E303 fulfills Accuphase's objective to produce an outstanding integrated amplifier with the same high quality performance of high quality separate amplifiers.

The E303 features an exciting new development in Hi-Fi — THE MOSFET POWER OUTPUT DEVICE. The MOSFET will ultimately replace the current transistor and valve designs of today in high quality amplifiers. It has far better sonic qualities than both without the inherent limitations of either.

The Accuphase E303 produces a very conservative 130 watts RMS/channel with less than 0.02% distortion and is designed for optimum perform ance with any loudspeaker load. Its quality and design are, of course, in keeping with the Accuphase "Grand Prix" award winning tradition.

The advanced specification of the E303 includes a Head-Amplifier with impedance matching facilities so that any moving coil cartridge can be used directly without the need for noisy external transformers or head amps. There is also a versatile tone adjustment system with variable loudness and turnover points.

For the technically inclined, some of the advantages of Accuphase's Power MOSFET are:

- Less active components, minimising phase shift.
- Extremely fast switching characteristics and negative temperature coefficient resulting in far less distortion.
- Less distortion in the extreme high and low frequencies due to an increased power band width.
- Instant switch on efficiency peak. Normal amplifiers take up to fifteen minutes to reach their peak efficiency.

RECOMMENDED PRICE $1698

You now have the opportunity to hear Accuphase's greatest achievement at the authorised dealers listed below.

West Australia
Alberts, PERTH
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NORTHLANDS.
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N.S.W.
Douglas Hi Fi,
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330 Pacific Hwy.,
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QUEENSLAND
John Gipps Stereo,
12 Douglas Street,
Milton 36 0080

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Accuphase

JAPANESE HI-FI COMPONENTS GRAND PRIX Winner 1979

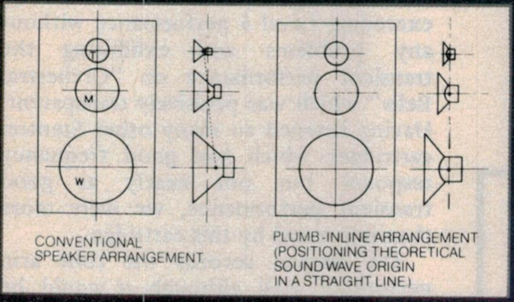
Sony gives it to you straight

When the Sony engineers developed the three-way range of speaker systems they did so with one simple principle in mind.

The end result must be as close to the original programme source as possible.

And as one might expect, Sony have come up with the answer.
And Sony's unique answer was the Plumb-Inline speaker arrangement.

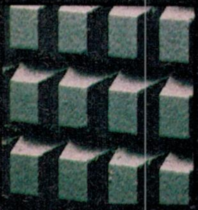
Quite simply it means that each speaker unit is aligned so that its sound wave origins, rather than its front edges, are at an equidistant point from the listener.



As you would expect from Sony, the results are superb. Frequency response across the entire audible range is smooth, stereo imaging and presence are improved and sound is clear and transparent.

In fact Plumb-Inline is only one of the many features of the Sony three-way speaker system.

It also features the A.G. (Accoustical Grooved) Baffle Board.



The baffle board has great influence on sound, especially in the mid-to-high frequency range. It not only weakens presence, but makes musical instruments and vocalists fuzzy. Sony's A.G. board effectively works at eliminating such influences, clearing sound and improving presence.

As a further development the system also features Computer-Assisted Design.

Here the Woofer, Mid-range and Tweeter Driver have each been designed based upon repeated listening tests and through the application of NASTRAN – a computer programme originally developed for the U.S. space programme and first used in the Apollo Project for studying vibration patterns under rapidly changing stress conditions.

These very real technical advances result in greater reality and presence through the reproduction of magnificent natural sound. Which is why people choose Sony in the first place.

Sony G-series and V-series speaker systems are available from around $300 to just under $900 each.

SONY®
AUDIO

AP 3255

Louis A Challis and Associates Pty Ltd

Our Ref: E12

MEASURED PERFORMANCE OF

THORENS TD105 TURNTABLE, SERIAL NO. 22813

RANGE OF SPEED ADJUSTMENT:	33 1/3 RPM	+4.9% -6.4%	
	45 RPM	+7.4% -5.6%	
WOW & FLUTTER:	Wow:	0.2% p-p	
	Flutter:	0.03% weighted RMS	
		0.08% unweighted RMS	
RUMBLE:	-29.0dB unweighted		
(re 2.24cm/sec @ 1kHz)	-55.6dB weighted (BS4852)		
FREQUENCY RESPONSE:	20Hz to 20kHz ±1.5dB		
SENSITIVITY:	Left	Right	
(at 1kHz)	1.4mV/cm/sec	1.6mV/cm/sec	
CROSSTALK:	100Hz	1kHz	6.3kHz
Left to right	-20dB	-24dB	-13dB
Right to left	-19.5dB	-20dB	-11dB
TONE ARM RESONANCE:	12Hz (see attached graph)		
TOTAL HARMONIC DISTORTION:	100Hz	1kHz	6.3kHz
(2.24cm/sec at 1kHz) LEFT	1.8%	1.8%	8.5%
RIFHT	1.7%	2.0%	5.8%
SENSITIVITY TO EXTERNAL VIBRATION:			

Noise resonances at 30 to 36Hz, 65Hz and 140Hz.

RMS for the flutter. The rumble performance is −29 dB unweighted and −55.6 dB weighted, in accordance with BS4852. These figures are quite good and better than the majority of belt drive turntables we have previously evaluated.

We spent a couple of hours carrying out a detailed subjective evaluation of the unit's performance with a series of test records, including direct-to-disc records and synthesised music records, incorporating significant transient content and warped records to see how the tone arm and Stanton cartridge would respond.

On the Shure TTR101 test record the cartridge performed admirably, exceeding Level 5 performance without any problems and exhibiting the transient performance on "Orchestral Bells" which was positively transparent. Having listened to many other Stanton cartridges which had good frequency response but not nearly as good transient performance, we were more than impressed by this cartridge.

On warped records the tone arm performed well although it could be induced to back track on warped records with damaged groove profiles.

Summary

Functionally, the record player was an absolute delight to use and exhibited no traces of the flutter problems which we have grown to expect as inherent to belt drives. In this respect, by making use of a larger strobe – mounted turntable structure and very high quality machined spindles the designers have produced a very commendable performance. In normal use we were unable to fault the performance of this unit in any way whatsoever and were very impressed by what Thorens (and Stanton) have achieved. ●

THORENS TD105 SEMI-AUTOMATIC BELT DRIVE TURNTABLE
(Fitted with a removable spring loaded acrylic lid)

Dimensions: 435mm wide x 125mm high x 335mm deep
Weight: 5.5kg Price: $389 RRP
Manufactured by Thorens-Franz Ag, Hardstrasse 41, CH-5430 Wettingen (Switzerland).

presume this is done to reduce problems of shielding and inductive pick up. Obviously, with different supply voltages it would be necessary to provide a different transformer for each country but this in itself presents no real problems and the idea, although unusual, is nonetheless very pragmatic.

Thorens, like other top line manufacturers, have not elected to specify in their literature any particular cartridge. The unit received by us was factory fitted with a Stanton TH500E. The arm will, however, accept any high compliance cartridge capable of tracking in the range 0.25-3 grams and we believe that any person buying the TD105 would be unlikely to purchase a cartridge tracking at more than three grams.

The objective tests that followed were as much an evaluation of the Stanton cartridge as they were for the TD105 itself.

Evaluation

The first test of the TD105, and specifically the TH500E cartridge, showed it to offer the best performance we have seen from any Stanton cartridge. The frequency response was ±1.5 dB from 20 Hz to beyond 20 kHz. The resonance characteristics were exceptionally smooth, particularly in the region around 17 kHz to 20 kHz. The channel separation of this cartridge is fair, being typically 20 dB at 1 kHz for the left channel and 23 dB at 1 kHz for the right channel, but is less than 10 dB only in the 10-20 kHz region. The square wave response of the cartridge is also excellent, exhibiting very little ringing which is again indicative of its smooth high frequency performance. The tone arm resonance characteristics, whilst reasonably good, exhibit a fairly prominent response at 12 Hz and appeared to have a sub-resonance somewhere below 5 Hz. This resonance, falling as it does below the normal range of recorded content and at a substantially different frequency from the main resonance characteristics should not normally prove to be a problem.

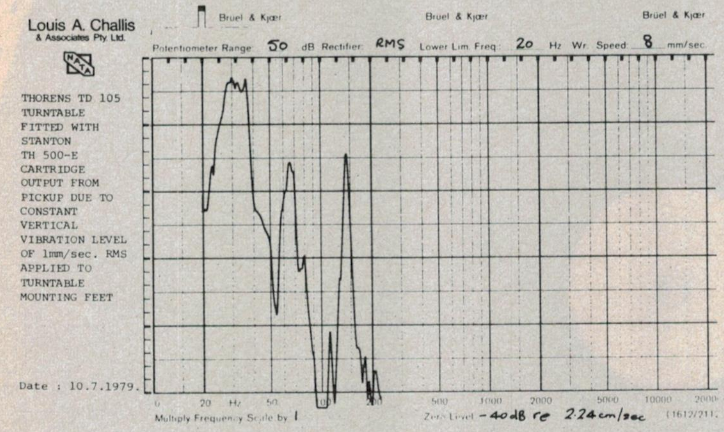
By contrast, the vibration isolation characteristics of the spring mounted integral turntable base exhibited significant resonances in the 30 Hz region, the 65-70 Hz region and (surprisingly) another dominant component at 145 Hz. This comes primarily as a result of the utilisation of springs without rubber or other damping materials and is surprising when most other manufacturers are tending to change to either spring and rubber or rubber spring isolation mounts. The degree of isolation provided by this system was less than we would have expected and could prove to be a problem if the unit were mounted in a location where there was significant structural borne vibration, especially from other components incorporated within the high fidelity system.

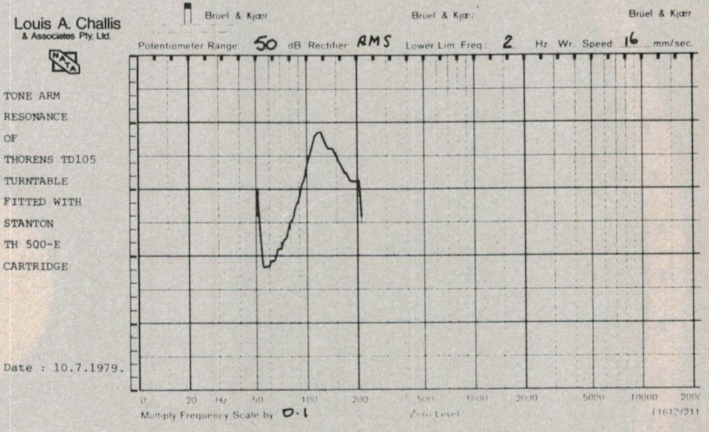
The belt drive motor brings the turntable up to speed in less than 2 seconds and once set, shows a deviation in speed accuracy of less than 0.01% from start to finish on a typical 350 mm diameter record.

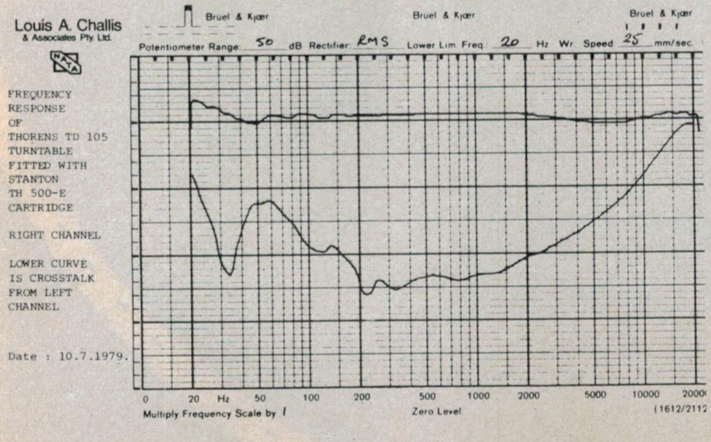
The regulator stability is quite impressive and the application of normal record cleaners does not trouble this unit to anywhere near the extent it does in other comparable and older belt drive turntables we have evaluated.

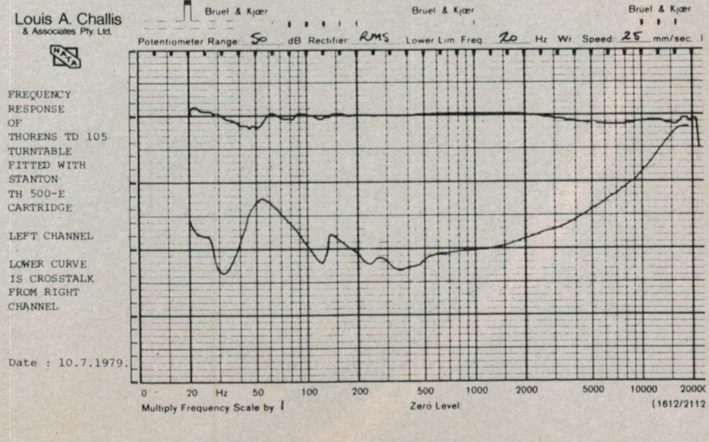
The vernier adjustment from the two speed regulator knobs provides at least a nominal 4.9% at 33 1/3 RPM and as much as 5.6% adjustment at the 45 RPM setting.

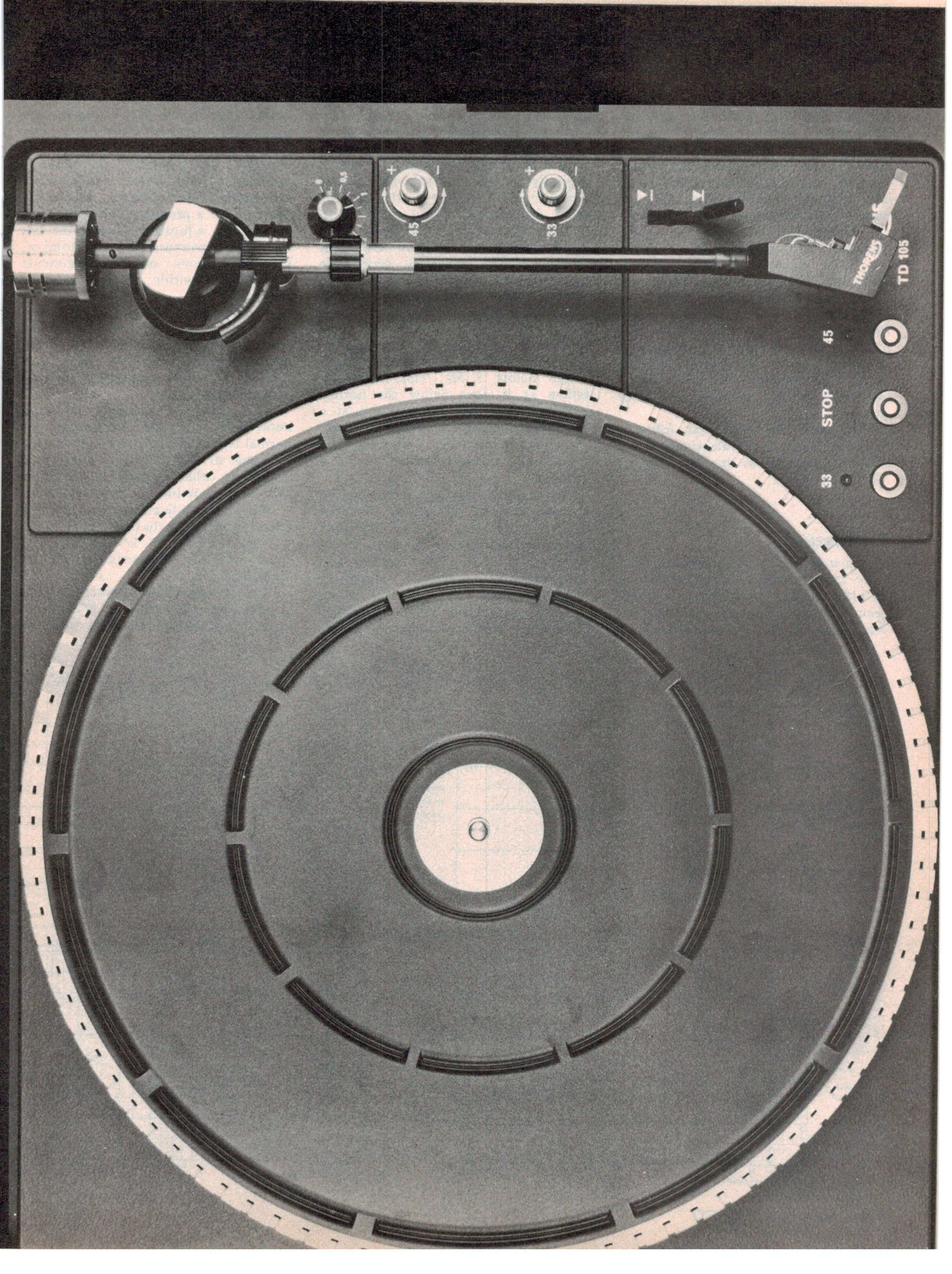
The wow and flutter figures are quite good being 0.2% peak to peak wow, with a low figure of 0.03% weighted










THORENS
TD 105
45
STOP
33

Thorens TD105 belt-drive turntable

Functionally simple, this turntable "... was an absolute delight to use and exhibited no trace of the flutter problems ... inherent to belt drives."

AT A TIME when most manufacturers are tending to switch their production to direct drive units it is intriguing that Thorens, a well respected manufacturer of record players, should offer a belt drive system. This unit incorporates a dc motor with an integral 72-pole tacho-generator and associated electronic speed regulator. This approach is quite different from other Thorens products we have previously seen and is attractive as well as being unusual. Following the world-wide trend, the record player base is moulded in black plastic. Many other components in the unit are also injection moulded from plastic to reduce costs and simplify production.

Features

The most striking feature of the unit is the turntable platter, a 1.3 kg zinc alloy, dynamically balanced wheel incorporating a series of radial slots on the upper and lower edges. These simultaneously provide a sensible location for adjusting the balancing and double as strobe viewing slots for fine adjustment of the record player speed. This feature is both sensible and effective but unfortunately gives an indication only at 33 1/3 RPM. The second set of slots is provided for use with 60 Hz mains. One must view the strobe light from the correct angle to achieve the desired indication.

The controls for the turntable are very simple. Firstly there are two electronic touch switches on the forward edge of the spring mounted plinth, with associated light emitting diodes indicating the selected speed. When either of these have been operated, the motor starts up the turntable but does not lift the tone arm. This must be performed manually, with or without the aid of the cueing lever, to position the stylus into the desired groove.

The turntable may be stopped by any of three methods. Firstly, the automatic stop at the end of the record, actuated by a system which detects the speed of the arm towards the centre. Secondly, touching the stop button. Thirdly, the action of manually returning the tone arm to the rest position which switches off the turntable.

Apart from the cueing lever, which is fairly rapid on the lowering cycle and which must be handled carefully as a consequence, the only other controls are the two individual knobs for fine setting of the 33 1/3 and 45 RPM speeds; an anti-skate adjustment and the main control weight at the end of the tone arm.

The tone arm itself does not follow the general trend of most other manufacturers in that it has a straight arm which the manufacturers claim utilises split wave technology (which is not defined in the literature). This is apparently based on the use of two materials with differing resonance characteristics to reduce tone arm resonance. The arm also makes use of a very unusual headshell which, whilst undoubtedly being functional, lacks the visual attributes that most headshells provide. Thus the wiring connections to the back of the cartridge are clearly visible which, in our opinion, detracts a little from the overall appearance of this particular unit.

Notwithstanding, the tone arm is beautifully balanced, very effectively gimballed and incorporates pivots which appear to provide almost negligible dynamic drag on the overall tone arm assembly. The designers of the arm have aimed to produce as low an effective tone arm mass as possible and have reduced the role of the headshell to that of simply supporting the cartridge structure. In this respect Thorens have produced something which is a departure from almost any other tone arm that we have seen. Another feature which we liked is the simple tone arm lock at the end of the arm rest. We think is extremely practical as well as being functional.

Another feature the manufacturers claim is the friction free velocity sensing electronic shut off for returning the tone arm automatically to its rest position. This is claimed to be superior to other systems but, whilst it is good, it is in no way revolutionary.

The last feature which caught our eye was the incorporation of an external ac adaptor transformer. This connects the unit to the mains and provides a 10 V ac output – required to power this unit and all its functions. This approach, whilst unusual, does remove the high voltage ac supplies from the unit itself, placing them at a remote location. We ▶

THE AUDIBLE EDGE

SUPERCOMPO

The world's first long-playing cassette deck...

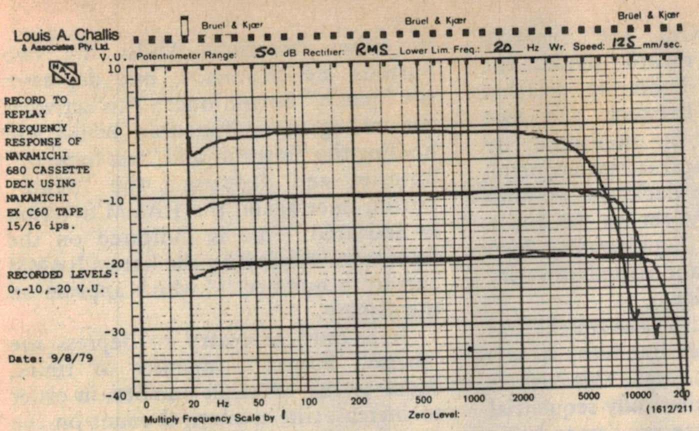
...is a Nakamichi, of course!

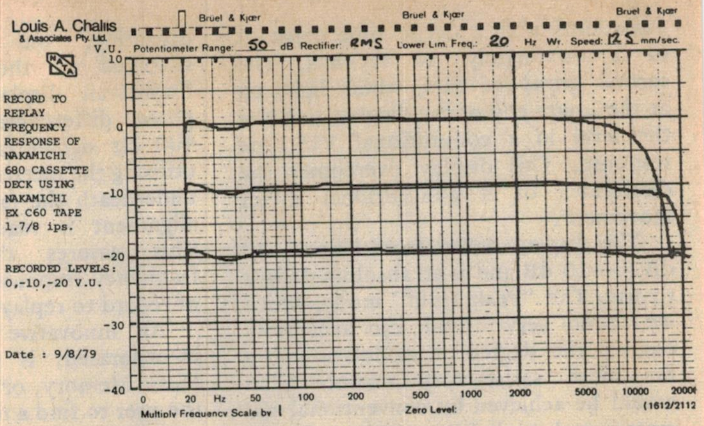
Imagine being able to record *three hours* of music on a C-90 cassette with the kind of fidelity only Nakamichi can deliver. Wishful thinking? Not with the new Nakamichi 680 2-Speed Discrete Head Cassette Deck. In addition to the standard tape speed of $1\frac{7}{8}$ inches per second (ips), the 680 is capable of record and play at half-speed, namely $\frac{15}{16}$ ips. And what's really amazing is that the 680's performance at half-speed is equal to or better than that of many modern component-quality cassette decks running at normal speed! Especially when combined with the new metal particle cassette tapes, the 680 at half-speed provides more than ample dynamic and frequency range for the recording of high-quality commercial program material (disk or FM).

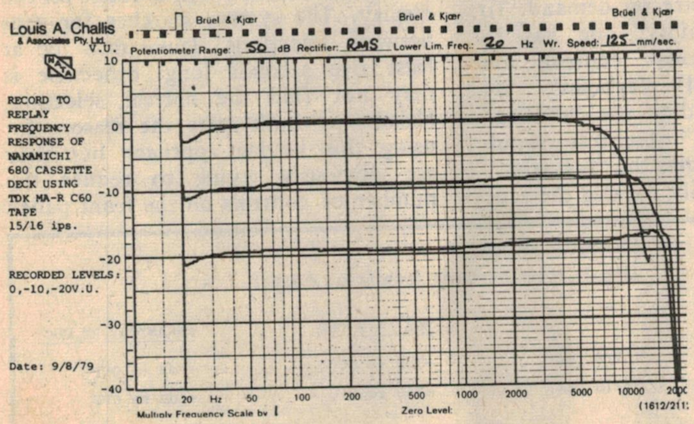
As you might imagine, there is some formidable technology embodied in the Nakamichi 680. This technology not only makes half-speed a reality, but also elicits the last ounce of performance from today's advanced tape formulations at standard speed.

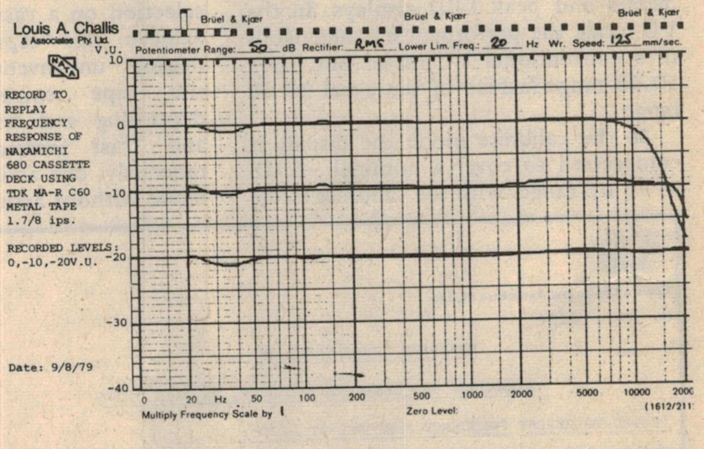
Nakamichi

From CONVOY INTERNATIONAL, 4 Dowling Street, Wooloomooloo, Sydney. 2011.









The other switch controls the machine offers (apart from the half-speed function) are manual selection for bias and equalisation for conventional gammaferric oxide, chromium dioxide (or cobalt doped) tape and metal tapes. It also incorporates a multiplex filter, Dolby in/Dolby out switches, three types of fluoroscan display, a timer switch for record or play, a tape/source monitor switch, and a master record level with balance control knob for convenience of level setting.

Across the centre of the deck were twelve potentiometers pre-set for reference level adjustment for three tape types at each of the two speeds for each channel.

The rear of the deck contains the conventional coaxial inputs and outputs as well as the DIN socket together with a dc power supply output for Nakamichi black box functions. It also contains a remote control socket suitable for either the conventionally wired remote control or Nakamichi's new infra-red controller.

The inside of the cabinet is not as awesome as we would have thought. It appears to contain much less electronics than either the Nakamichi 700 or 1000 decks. The electronics are laid out on three large printed circuit boards, fully labelled for maintenance and accessability. There is a large amount of inter-wiring, although it is all neatly colour-coded and mostly terminated in sockets. The fluoroscan display is contained in a separate metal shield box. The tape drive mechanism is extremely smooth with its three-motor configuration and is virtually silent when running.

Evaluation

The instrumental testing we carried out was far more detailed than normal owing to the large number of parameters which needed to be evaluated because of the two speed modes and three tape types.

The performance is, to say the least, unrivalled – particularly at 48mm/sec where Nakamichi achieve everything they claim. The frequency response at –10 to –20 VU, not only with the metal oxide tape but also gammaferric oxide tape, is *exemplary*. The performance at 24mm/sec, even with gammaferric oxide tape, is satisfactory, being –3 dB at 13 kHz.

The wow and flutter figures, as well as the other measured parameters, are exceptional and make this machine *superior to the Nakamichi 1000 in virtually all respects.*

We derived a great deal of pleasure from the subjective assessment. The quality of its performance at 48mm/sec rivals any reel-to-reel machine we have ever tested. We believe that this class of performance must lead to a further decline in the use of reel-to-reel machines except for professional and serious amateur applications. The quality of the sound with Dolby in use has now reached the point where perfectionists would prefer to use a "dBX" system or contemplate the cost of Nakamichi's Hicom II.

At 24mm/sec tape speed the performance is reasonably good. In fact, it is nearly as good as the majority of other machines on the market, played at 48mm/sec.

With the innovative features it provides and its excellent performance, the Nakamichi 680 will undoubtedly gain a greater share of the top end market than the 700 or 1000 Nakamichis ever had. ●

NAKAMICHI 680 DISCREET HEAD TWO-SPEED CASSETTE DECK

Dimensions: 482mm wide x 143mm high x 340mm deep
Weight: 9.1kg Price: Approximately $1,300
Manufactured by the Nakamichi Corporation, Tokyo, Japan.

peak level with a decay time constant of approximately 10 seconds. The second group of bars, which light up at the lower end of the display, indicate the level in a conventional VU type response. This display overcomes the disabilities of a conventional meter movement.

The display covers from below −40 dB to +10 dB and is an absolute delight to use. The "Peak Hold" mode, which we found very useful, can accurately control the degree of modulation in a far more satisfactory manner than would be achieved by conventional VU meters and peak LED displays. In the VU mode the performance is analogous to a conventional VU meter but has a 50 dB range instead of the usual 20 dB range.

In the calibrate mode the display is compressed to cover a nominal −5 dB to +3 dB range. With the calibrate mode operating, and with the recorder switched to the record mode, the fluoroscan display lights up so that phase differences between the two 400 Hz signals can be monitored. By utilising the mechanical azimuth control, underneath the tape deck, the azimuth alignment is readily set to ±0.2 dB. This assures the maximum high frequency response and overall linearity of record to replay signal.

An innovative idea Nakamichi has incorporated, is the Random Access Music Memory, or RAMM. This enables the user to find a numerically sequential selection on a cassette on demand. To achieve this capability, one has to master unconventional controls on the tape control keyboard. By depressing and holding the "rewind" and "fast forward" controls simultaneously, one activates the "fast wind" mode without actually moving the tape in either direction. Whilst the two buttons are depressed, one depresses the "pause" button once. This activates the cueing mode function. Whilst still holding the "rewind" and "fast forward" buttons, and depressing the "pause" button once again, the RAMM function is activated. This is indicated on the fluoroscan display by the letters RAMM and by a number '1' which appears on the display.

It is only necessary to depress the "pause" button a number of times, equal to the selection number, in order to increase the numerical count on the display. The system searches for gaps between selections. These must be at least five seconds long, otherwise it may not find the correct selection. Nakamichi don't state the reasons for using this keying approach but they are obviously trying to reduce the number of controls on the front panel. ▶

LC

Louis A Challis and Associates Pty Ltd

Our Ref: E15

MEASURED PERFORMANCE OF

NAKAMICHI 680 CASSETTE RECORDER, SN A112 01065

RECORD TO REPLAY FREQUENCY RESPONSE AT -20VU:

Speed: 1 7/8 ips:

Tape	Dolby	Lower -3dB Point	Maximum Point	Upper -3dB Point
Nakamichi EX C60	Out	<20Hz	+0.5dB (20Hz)	>20kHz
Nakamichi EX C60	In	<20Hz	+0.0dB (1kHz)	>20kHz
TDK SA C60	Out	<20Hz	+0.8dB (100Hz)	20kHz
Nakamichi ZX C15	Out	<20Hz	+1.0dB (20kHz)	>20kHz
TDK MA-R C60	Out	<20Hz	+0.3dB (5kHz)	>20kHz

Speed: 15/16 ips:

Tape	Dolby	Lower -3dB Point	Maximum Point	Upper -3dB Point
Nakamichi EX C60	Out	<20Hz	+0.8dB (2.5kHz)	13.5kHz
TDK MA-R C60	Out	<20Hz	+2.0dB (14kHz)	16.5kHz

SPEED ACCURACY:

1 7/8 ips: nom: 0.2% fast range: -6.8% to + 8.4%

15/16 ips: nom: 1.6% fast range: -5.5% to +10.4%

WOW AND FLUTTER:

(record to replay)

1 7/8 ips: Flutter: 0.05% wtd rms 0.07% unweighted rms

Wow: <0.1% p-p

15/16 ips: Fluter: 0.13% wtd rms 0.18% unweighted rms

Wow: 0.2% p-p

NOISE:

(re OVU)

	Dolby	TDK MA-R C60 dB(lin)	TDK MA-R C60 dB(A)	NAKAMICHI EX C60 dB(lin)	NAKAMICHI EX C60 dB(A)
1 7/8 ips:	Out	-48.0	-52.0	-44.0	-47.5
	In	-55.0	-61.0	-52.0	-57.0
15/16 ips:	Out	-45.0	-50.0		
	In	-53.0	-59.0		

MAXIMUM INPUT LEVEL:

(for 3% third harmonic distortion @ 1kHz)

	TDK MA-R C60	NAKAMICHI EX C60
1 7/8 ips:	+7dB re OVU	+6dB re OVU
15/16 ips:	+2dB re OVU	+1dB re OVU

ERASURE RATIO:

(for 1kHz signal recorded at 3% third harmonic distortion)

	TDK MA-R C60
1 7/8 ips:	-77.3dB
15/16 ips:	-87.3dB

D.F. CRAIG
10th August, 1979.

TOTAL HARMONIC DISTORTION:

TAPE		15/16 ips 100Hz	15/16 ips 1kHz	15/16 ips 6.3kHz	1 7/8 ips 100Hz	1 7/8 ips 1kHz	1 7/8 ips 6.3kHz
Nakamichi EX C60							
OVU	2	-55.0dB	-52.4dB	-48.5dB	-55.8dB	-56.0dB	<-57.0dB
	3	-32.4dB	-30.9dB	-37.8dB	-43.3dB	-43.9dB	-38.1dB
	4	-	-	-	-	-	-
	5	-63.9dB	-45.5dB	-	-	-	-
	THD	2.41%	2.91%	1.34%	0.70%	0.66%	1.24%
-6VU	2	-59.6dB	-56.8dB	-51.3dB	-57.2dB	<-59.0dB	<-55.0dB
	3	-45.7dB	-43.1dB	-42.0dB	-59.3dB	-53.5dB	-48.5dB
	4	-	-	-	<-68.0dB	-	-
	5	-	-	-	-	-	-
	THD	0.53%	0.71%	0.84%	0.18%	0.21%	0.38%
TDK MA-R C60							
OVU	2	-63.1dB	<-58.0dB	-50.0dB	-68.3dB	<-64.0dB	<-54.0dB
	3	-34.6dB	-35.6dB	-31.9dB	-41.6dB	-44.6dB	-33.2dB
	4	<-72.0dB	<-61.0dB	-	<-76.0dB	<-67.0dB	-
	5	-63.0dB	<-65.0dB	-	-71.5dB	<-67.0dB	-
	THD	1.86%	1.66%	2.56%	0.83%	0.59%	2.19%
-6VU	2	-66.7dB	<-58.0dB	<-50.0dB	-65.5dB	<-61.0dB	<-52.0dB
	3	-44.9dB	-46.5dB	-37.2dB	-52.6dB	-53.4dB	-41.0dB
	4	<-71.0dB	<-62.0dB	-	-72.0dB	<-65.0dB	<-57.0dB
	5	<-73.0dB	<-67.0dB	-	-73.3dB	<-65.0dB	-
	THD	0.57%	0.47%	1.38%	0.24%	0.21%	0.89%

able to achieve a remarkable 0.2% peak to peak unweighted wow and a 0.12% weighted RMS flutter performance.

For the last three years Nakamichi (and we presume other manufacturers) have been carrying out serious research into the use of metal tapes. Whilst metal tape is not a new concept, it has had the obvious attributes derived from the coercive force and remanence being nearly twice as high as for conventional metal oxide tapes.

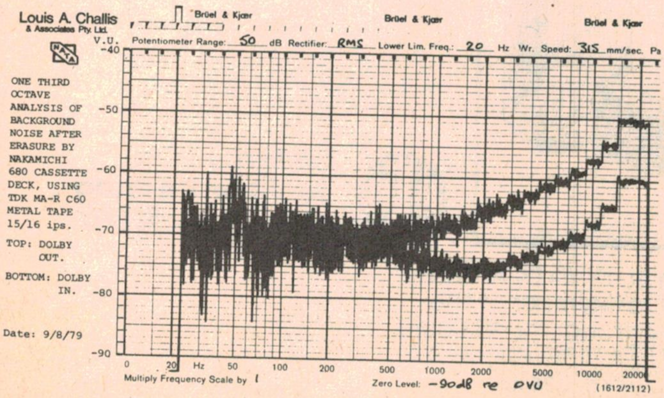
Metal tape had serious deterioration problems. Early tapes had a typical "half life" of one year (the recorded energy drops to 50% of the initial value). The manufacturers appear to have overcome the problem so that the drop in performance is now only typically 5% (-0.5 dB) per year. It may surprise you to find this is also typical of the performance loss from your conventional gammaferric oxide tapes. But, the current asking price for metal tapes is typically twice that for the best premium gammaferric oxide and ultra dynamic tapes.

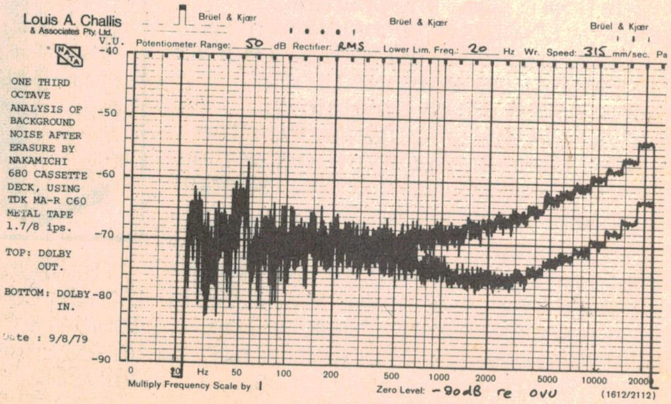
The unit

The unit we received for testing was not new. In fact, we first saw it at an Audio Engineering Society Meeting in July, 1979. Since then it has done many operational miles.

The front panel of the 680 is very impressive. It features that ubiquitous white engraving on a black background and is a knob twiddlers delight. The 680 is smaller than a Nakamichi 1000 and about the same size as a 582. The cassette well, which is operated by a smooth ejection mechanism, pops out when a lever on the left hand side of the escutcheon is depressed. The cassette is fully in view whilst being played, through a clear acrylic type panel. This is interlocked with the drive mechanism so that the cassette cannot eject until the "stop" mode is selected. The controls are finger-touch electronic switches arranged rather unconventionally in two groups of three. The facilities and functions which these switches perform are also unconventional.

The fluoroscan display, positioned at the top of the panel is not novel. However, it provides features which are as innovative as they are excellent. It consists of two series of vertical, blue bar lights on a black background, with decibel values between. One segment of bars indicate the weighted ▶





The Nakamichi 680 — hi fi at half speed?

SCOOP!

This two-speed cassette deck, with a half-speed capability, "... must lead to a further decline in the use of reel-to-reel machines ..." and has performance "... superior to the Nakamichi 1000 in virtually all respects".

FOR THE LAST seven years, the Nakamichi 1000 has generally been regarded as one of the best cassette decks that money can buy. With the release of the Nakamichi 582 earlier this year, we found a machine which, in most respects, equalled or exceeded the performance of the Nakamichi 1000. This improvement came in part because it provided capability for metal oxide tapes as well as incorporating mechanical improvements.

Nevertheless, most equipment is soon surpassed by something that is better – it is obvious that the 680 is that machine to Nakamichi's existing line-up.

In planning for a successor to the 1000, Nakamichi's technical staff had to make some very serious and far reaching decisions. Would they go to double speed? Would they rest on their laurels? or would they look for an entirely different approach?

Their choice was counter to the market trend in that they decided to include a 24mm/sec (15/16"/sec.) half-speed capability in parallel with the standard 48mm/sec (1 7/8"/sec.) tape speed.

Their reasons for doing this were reasonably clear. The performance of conventional cassette recorders at normal speed has now reached the point where machines can offer the ultimate in frequency response at 48mm/sec. With such performance, there is little justification in going to double speed. If one offers a tape deck further extended in frequency response through the use of metal tape (which already costs twice as much) there should be some offset in running cost if the half speed performance is still acceptable.

Design hurdles

Nakamichi had five problems to solve in order to make the half-speed machine acceptable in the marketplace.

The first problem was to achieve a genuine 20 Hz to 15 kHz frequency response, ±3 dB. Nakamichi's early research showed that the conventional erase head caused "partial erasure" (some de-magnetisation) especially of the high frequency content, as a tape being replayed passed over the head. This came as a result of self-magnetisation of the replay head's magnetic core. This could cause a very shallow surface erasure to a depth as small as 0.1 micron which would typically result in a 4 dB loss of signal level at 15 kHz.

Nakamichi developed a completely new erase head configuration which makes use of new magnetic materials and an entirely different configuration, to obviate the problem.

The second problem was that, in order to obtain a 15 kHz record/replay capability at 24mm/sec, the basic playback head frequency response had to exceed 30 kHz at 48mm/sec. This required a head gap width of less than 0.8 micron. Nakamichi chose a head gap width of only 0.5 micron. He coupled this with a completely new mechanical support system. This reduces the physical distortion of the head components during machining. In particular, in the standard mode Nakamichi aimed to achieve ±1 dB frequency response from 20 Hz to 20 kHz at -20 VU. This is a better performance than most professional reel-to-reel machines can achieve.

The third problem was the azimuth alignment. If this is a problem at a tape speed of 48mm/sec, it is an even greater problem at 24mm/sec. To achieve adequate performance it became mandatory to provide azimuth alignment facilities, that decks such as the Aiwa 6900 have been providing, to optimise the phase response between left and right channel. This problem is overcome by the introduction of a calibrate mode using the fluoroscan display (explained later).

The fourth problem that Nakamichi had to overcome was providing good signal noise ratio. This is not so important at 48mm/sec, but is at half speed. On a theoretical basis, halving the speed would reduce the signal to noise ratio by 3 dB. By careful design and by making maximum use of the properties of the A-weighting filter, this has been reduced to a 2 dB(A) reduction. Obviously the utilisation of the Dolby facility further improved this performance and Nakamichi's recently developed Hicom II noise reduction process further extends this capability by 20 dB over the full spectrum.

The last problem of the half-speed capability is the very serious one of wow and flutter. This has plagued many conventional cassette decks at 48mm/sec. Halving the speed can result in a theoretical increase in wow and flutter of four times. This is because fly wheel efficiency is proportional to the inverse of the rotational speed, squared.

Obviously, one can reduce the problem by aiming for finer and finer machine tolerances to lower imbalance forces. Nakamichi found another way to circumvent this problem, as we recounted two months ago when reviewing the Nakamichi 582 deck. By altering the resonance characteristics of the individual components within the deck, through the use of what Nakamichi call their "diffuse resonance system", the overall wow and flutter performance is significantly improved. Using finer tolerance for dynamically balancing the fly wheel and other machine components, Nakamichi was

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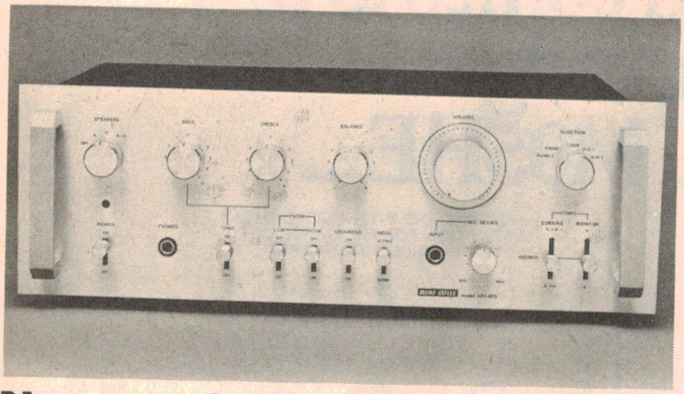


New amp from Audio Reflex

The latest offering from Audio Reflex is this economically-priced integrated amplifier with 65 W RMS per channel output and 0.05% THD across 20 Hz to 20 kHz, according to the manufacturer's claims.

Known as the ARA665, the unit features a tone defeat switch for reproduction uncoloured by tone control circuitry, tape dubbing facilities, level control mixing mic circuitry, separate preamp and main amp operation, two phone and two tape inputs along with a subsonic rumble filter and a high cut filter.

Speaker protection circuitry is included to prevent damage due to any amplifier malfunction and also serves for muting switch-on noises.

The subsonic and high-cut filters have a 12 dB/octave rolloff, according to the Audio Reflex literature, and a standard loudness control is also included.

The unit is finished with a silver facia and has clickstop volume, tone and balance controls. The recommended retail price is $399 and further information can be obtained from Audio Reflex, 7 Orchard Road, Brookvale 2100 NSW, (02) 938-4188.

Leader test gear

The well-known range of Leader test equipment, now distributed in Australia by Vicom International, incorporates a number of audio test instruments. Released recently was a noise and distortion meter, Model LDM170.

This convenient unit will measure, across the audio range of 20 Hz to 20 kHz, distortion figure as low as 0.03%, and up to 100% at the other extreme, according to Leader's specifications.

In addition, the unit permits noise measurement from 0 dB to -70 dB, below the reference level.

The LDM170 can also function as an ac level meter with a range from 1 mV to 300 V RMS full scale in twelve ranges.

A 1 kHz selective filter is included and an oscilloscope output is available to aid in the analysis of distortion components.

The LDM170 costs less than $650 tax paid and is available through the following Vicom distributors: Radio Parts in Melbourne; George Brown and Co. in Sydney; Atkins Carlyle in Perth, Electronic Equipment and Components in Adelaide and Fred Hoe and Sons in Brisbane.

For more information, contact Vicom, 68 Eastern Rd, South Melbourne Vic 3205, (03) 699-6700.

A.G.S. change name

The company formerly known as A.G.S. Electronics (Australia) Pty Ltd have advised us that, as from 1 August this year, they wish to be known as Audio Reflex (Australia) Pty Ltd.

The Audio Reflex range of products is well known on the local hi-fi scene, the range includes turntables, amplifiers, graphic equalizers, cassette decks, tuners, speakers and a line of car audio products.

Audio Reflex are located at 7 Orchard Road, Brookvale 2100 NSW, (02) 938-4188

New Quad Speaker!

We're delighted to report that there really **is** a new Quad electrostatic speaker in the offing. The prototype (and the manufacturerer's MD is at pains to emphasise that it really **is** only a prototype) was demonstrated to the Audio Engineering Society in London on June 12th.

Few technical details are currently available but it is possible/probable that the design incorporates multiple radiators interconnected via delay lines. The prototypes appeared to be taller than the earlier production units and were clearly capable of handling much higher levels.

Philips hold on metal tapes

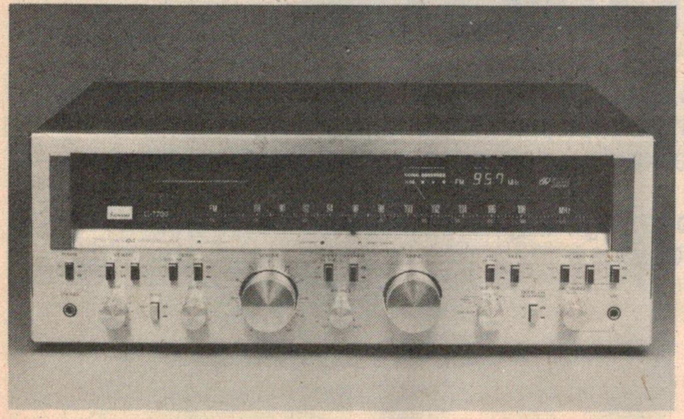
According to the British magazine 'New Scientist' Philips has decided to withdraw from metal tape production — just five months after it announced that it was proposing to enter the market. Apparently the company is not satisfied with the products produced so far.

BSR into videodisc?

BSR (in the USA) may market a version of the RCA SelectaVision videodisc design. The company is known to be studying the RCA capacitance pick-up system — following a technical agreement between the two companies.

Hitachi self-biasing deck

Hitachi has released a new front loading cassette deck using a microprocessor which automatically optimises bias and equalisation for normal chrome and ferri-chrome tapes. The machine rivals JVC's model KD-A8 (details ETI p.18 April '79).



Unique tuning system in new receiver

Incorporating a patented "digitally quartz-locked tuning system", Sansui claim improved spurious rejection ratio, tuning accuracy and signal-to-noise ratio from their new G-7700 FM/AM integrated stereo receiver-amplifier.

The received signal is digitally processed to detect and correct tuning errors and receiver drift.

A feature of the G-7700 is the combination of a conventional slide-rule dial and a digital frequency display.

The power amplifier section of the receiver features a capacitor-less dc amplifier design with a claimed rise time of 1.4 usec for a slew rate of 60V/usec. Total harmonic distortion is quoted to be as low as 0.025%.

Sansui claim the amplifier will deliver 120 watts RMS per channel (both channels driven into 8 ohm load) from 20 Hz to 20 kHz.

Further information is available from Vanfi, 162 Albert Rd, South Melbourne Vic 3205, (03) 699-5473.

Adelaide FM stations share antenna

Stations 5MMM and 5EB1 will share a common antenna when they go to air later this year.

This will be made possible by means of a diplexer, a special filter unit in the antenna transmission line that combines the two transmissions going to the antenna while isolating the transmitters from one another.

Manufactured by Antenna Engineering Australia Pty Ltd, the diplexer will provide isolation of 70 dB between the two transmitters at channel centres and a minimum of 40 dB at the channel edges, A.E.A. claim, with an insertion loss of only 0.2 dB.

The two stations will be running 2.5 kW, but the diplexer is rated to carry 10 kW per channel. Station 5MMM will be on 102.3 MHz, the licence being held by the Progressive Music Broadcasting Association, while 5EB1 is licensed to Ethnic Broadcasters Incorporated and will transmit on 103.3 MHz.

Maxell's new tape lineup

The updated range of quality Maxell tapes, released last month by Hagemeyer, will be of interest to the cassette enthusiast.

Bringing improved performance for the same cost, the range includes Low Noise, Ultra Dynamic, UDXL I and UDXL II tapes, each in an up-graded package featuring leader tape with a five second cueing mark.

The UDXL II tape is designed for 70 us equalisation with a high bias setting, while the other three in the range require 120 us equalisation with normal bias levels.

For further information on these tapes, contact Hagemeyer (Australia), 25-27 Paul Street, PO Box 307, North Ryde, NSW 2113 (02) 887-1444, Telex AA22214.

Pocket radio is only 12 mm thick

With its "slim, trim" design, just right for really slipping into a pocket, Sanyo's recently released RP1900 receiver should be popular this summer.

Featuring what Sanyo describe as "an advanced LED tuning indicator", the receiver has 180 mW output from a 40 mm diameter speaker. The latter incorporates a rare earth magnet and a film cone.

The receiver runs off three AAA cells and is supplied with a soft carrying case. Overall size is 129 x 67 x 12 mm. Recommended retail price is $51.

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Philips N6330 Electrodynamic Headphone (Below)

Although N6330 (Philips' range leader) is a conventional electrodynamic headphone, there is nothing conventional about the revolutionary design concepts that ranks these phones with any competitor in the world today. And **not** as expensive as you would expect.

Philips N6325 Electret Headphone (Above)

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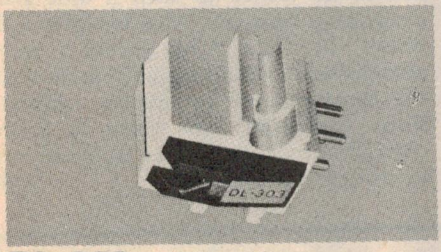

DL-303

Output voltage:	0.2mV (1kHz, 5cm/s)
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Channel balance:	1dB or less (1kHz)
Static compliance:	35×10^{-6}cm/dyne
Dynamic compliance:	13×10^{-6}cm/dyne
Stylus tip:	Special elliptical solid diamond tip having a 0.1×0.05mm rectangular section
Stylus force:	1.2 ± 0.2g
Weight:	5.8g

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AU-340 transformer

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DL-303 ART OF GENIUS

High grade record of the latest recording with its feature of wide range containing great quantity of sharp pulse components has extremely complicated record groove. It is said that when tracing this record groove, unexpectedly large force is applied to the groove wall when it comes to the percussion or other impulsive sound, due to the effective mass at the tip of stylus. The most fundamental point in disc reproduction is to allow the most truthful and accurate tracing as well as protecting the complicated record groove from "damage or abrasion"... "Art of genious... DL-303" the model created in pursuit of the reduction of the mechanical impedance opens the door to the new world of marvellous performance of MC cartridge.

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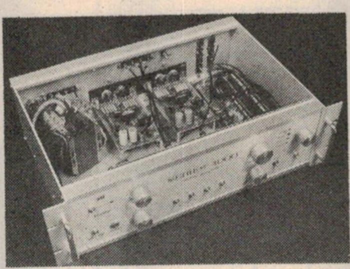

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the brain mechanisms which underly human behaviour.

In such a model, the transitions from one state to the next correspond to "thought processes", while learning is embodied in the fact that the element functions can change in response to information received by the network. It is possible, using this approach, to describe many psychological and physiological functions in terms of state-to-state activity, and processes such as recognition of environmental events, recall of stored information, long-term and short-term memory processes, and a mechanism of speech production are but a selection of functions which may be described and characterised in this way. The benefits likely to be obtained in this area are twofold since, not only can such endeavours lead towards a clearer understanding of brain function itself, but such a characterisation of intelligent behaviour can give insight into the design of intelligent machines for many different purposes and applications.

What of the future?

One thing is certain, the search for machines with a capacity for intelligent behaviour will continue and increase.

One of the most encouraging features of the approach described here is that it focusses as a unified entity the work of engineers, physicists, mathematicians and even psychologists. It may be that the current trend towards cheaper and more readily available computing facilities and electronic components will provide exactly the right stimulus for even more widespread and inter-disciplinary cooperation, and allow significant progress in this area.

Further reading

Further reading on these and related topics can readily be found by scanning the scientific literature in cybernetics, computer science and digital electronics. To mention just one specific reference cannot do justice to such a wide and challenging field, but "The Metaphorical Brain" by M.A. Arbib offers a very readable and stimulating introduction to the basic aims of cybernetics, emphasising particularly the value of brain research in tackling engineering problems in artifical intelligence. ●

THE SYSTEM described in this article is still in an early stage of development but Kent University does have a less advanced system working. This is a computer simulation of a 'learning net'.

In the example in these diagrams, the machine is learning to recognise typewritten characters. Figure 4 shows the digitised picture information being fed into the array at the top left of the diagram (the pattern shown is a letter T).

There are several blocks of RAM attached to this array, each organised as 16 x 1 bits. The address lines are fed from different parts of the array, the entire array being covered all in all.

This entire network (i.e.: the part of Figure 4 inside the dotted line) is dedicated to recognising one character. During the 'teaching' mode, the letter to be recognised is fed into the array. The 'teach enable' and the 'teach data' of the network are held high and a '1' will be fed into the location of each RAM which is indicated by the input pattern.

A variety of other patterns (i.e. other than "T") are then fed into the array and a "0" is fed into the locations indicated by the new patterns.

During the run mode, an 'unknown' pattern is fed in and the network which has been 'taught' to recognise it will produce a lot of "1's" at the RAM outputs.

The system will see which network is producing the most "1's" and will output the character that that network (the one with the most "1's") is trained for (see figure 5). In this way the system can cope with 'noisy' patterns — they will still (hopefully) produce more "1's" in their network than in any other.

At Kent University they are using the system on data supplied by the GPO. The data consists of arrays derived directly from typewritten material. The result is a very 'noisy' pattern, difficult for a human to identify. However the system is managing well.

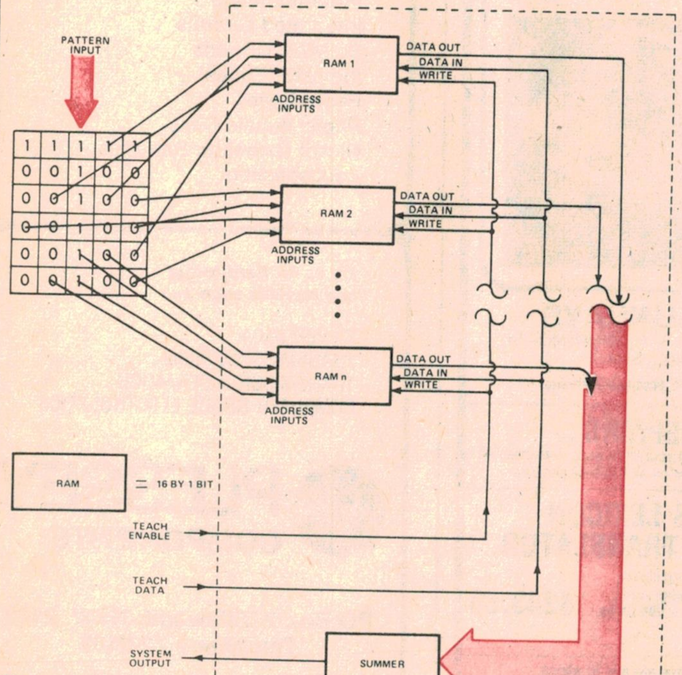

Figure 4: **Block diagram of a machine to simulate a network.**

(These diagrams by Phil Cohen)

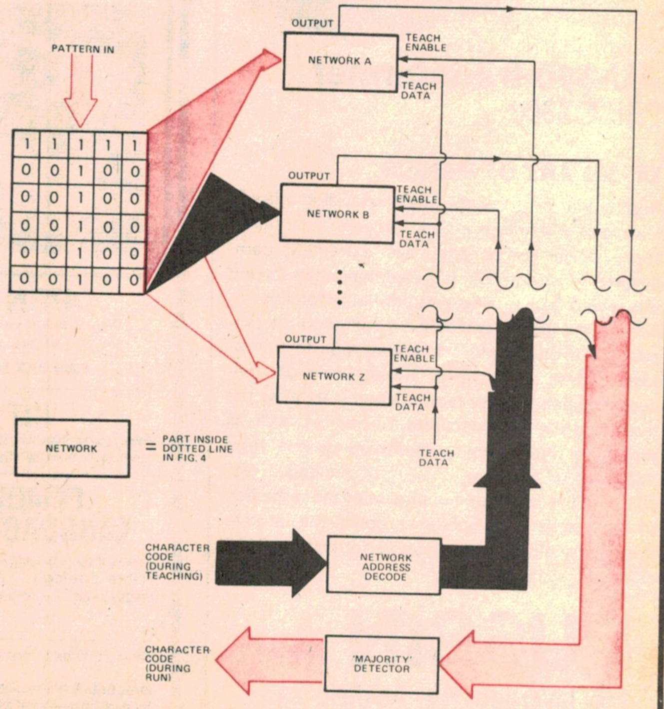

Figure 5: **Several networks connected to recognize a character.**

of activity and is, therefore, stable.

This inherent ability of the network to organise its behaviour into one of a well-defined number of modes of activity leads us to attribute to the network a pre-disposition for intelligent behaviour, in just the same way that we might feel inclined to attribute intelligence to our "chaotic" filing system if we opened a drawer to find out, despite our lack of coordination, all the files on "Mr Brown's interview" had ended up together in one place.

Three further points need to be made clear in the context of intelligence in networks of electronic processing cells. First, we may allow the network to interact with its environment by allowing some of the element input channels to be connected to the external world rather than to other cells. In this way the network can be made to respond to some stimulus by following a trajectory of transitions to some state cycle. Second, if we arrange for the element functions to be variable (i.e: we allow them to change if some appropriate signal is received) then the state structure is itself variable, and the network can be made to learn, making meaningful associations between external events and its own possible modes of major significance — all the required properties of the electronic cells utilising cheap random access memory devices to implement the electronic cells which make up the network.

Although the idea will be pursued later it is worth pointing out at this stage that the overall structure of the electronic system as described is not unlike the structure of the brain. It has two extremely important features in this respect.

First, the intelligence of the system is not localised in any specific area, but distributed over the entire network. As a result the system is much less susceptible to localised damage than more conventional electronic systems, in much the same way that our memory traces can often be retained despite severe disruption of the brain's activity. Second, the system processes its data in a *parallel* rather than *serial* mode, (all the cells operate simultaneously) with a consequent ability for high processing speeds.

Let us suppose that we wish to construct a device which will automatically read and identify letters of the alphabet (clearly a task requiring 'intelligence', whether carried out by a man or a machine). A simple scheme for accomplishing this task is shown in Figure 3. A TV camera is used to sense the image which is then encoded (or "digitised") by means of suitable circuitry into a binary representation, and this coded version of the input fed to a network of adaptive electronic cells as described.

We now exploit the natural intelligence of the network by modifying the element functions — "teach" the network — in such a way that it will respond to examples of a particular pattern class (e.g. the letter "A") by entering a particular state cycle, the equivalent of executing just one of its possible modes of activity. The classifier is then required to identify the cycle entered and hence signal the identity of the pattern which was received at the input.

It is easily seen that the system is making use of the natural stability of the network in so far as the number of states which need be identified is dramatically smaller than the total number of possible input patterns which may occur. It is exactly this property of the network which transforms the problem from one of identifying a potentially very large set of inputs to the much simpler problem of identifying one out of a much smaller number of possible cycles.

Intelligence and models of the brain

The human brain is a cellular structure whose processing units are biological computing cells called neurons. Although the computational mechanisms of electronic cells and biological neurons are very different, there are nevertheless similarities in terms of the respective functions performed. For example, both types of cell operate on signals which are essentially binary in nature — in terms of voltage levels in the electronic case and the generation or non-generation of voltage pulses in the biological case — and both compute a function relating an output signal to the pattern of signals appearing on their input channels at any instant. Structurally at least the type of electronic network described above is a closer model of the brain than is a conventional computer system.

Furthermore it is possible, in principle at least, to characterise brain activity in terms of a state diagram. Although a complete state diagram of the brain if it could be plotted exactly would contain about $2^{10^{10}}$ states (since it is estimated that the brain contains about 10^{10} neurons), a model of a neural network, which could of course be physically realised using our familiar electronic network structure, can be a very versatile means of characterising and formalising

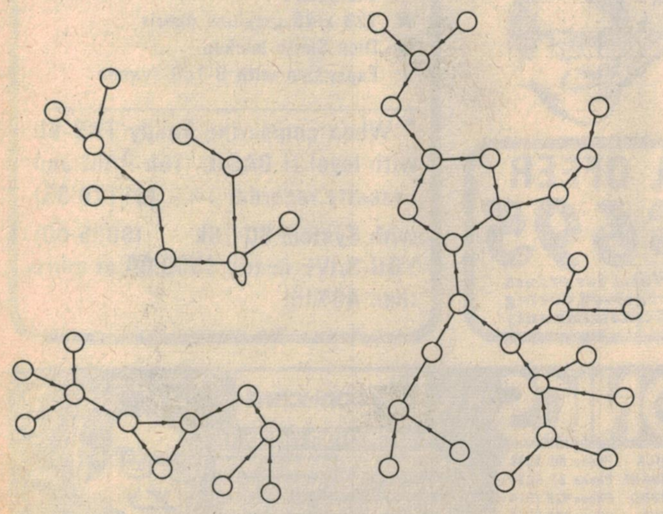

Figure 2: **Part of a 'State Transition Diagram' summarising the behavior of a network of cells, showing the changes from one state to the next at successive instants.**

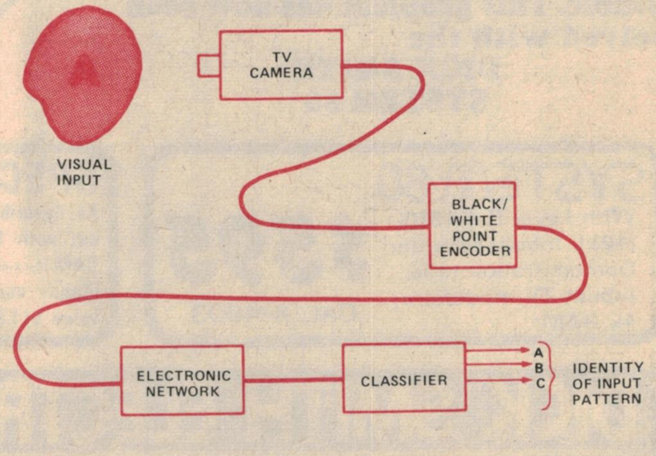

Figure 3: **A simple method of recognising visual patterns.**

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0	0	1	Q_1
0	1	0	Q_2
0	1	1	Q_3
1	0	0	Q_4
⋮	⋮	⋮	⋮
1	1	1	Q_i

Table 1: **Showing the association between possible sets of inputs to the cells at right and their corresponding outputs.**

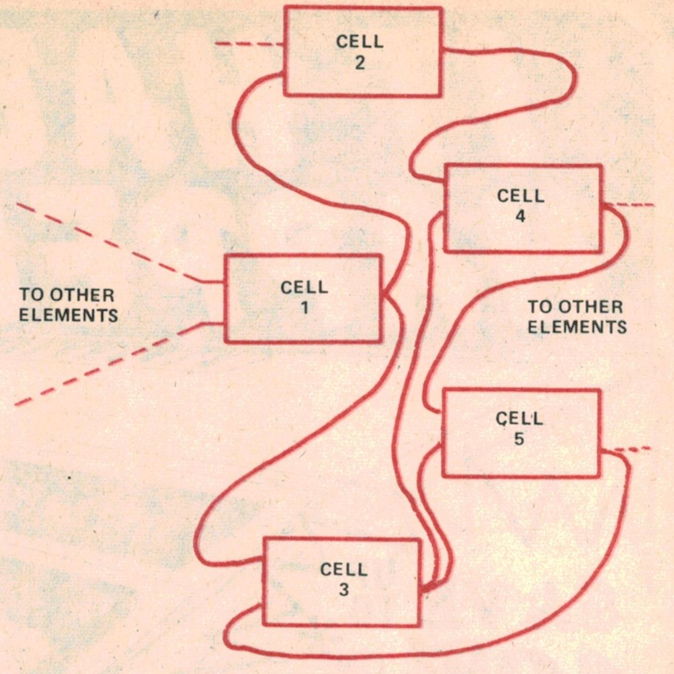

Figure 1: **A network of interconnected electronic cells. Each can receive and generate binary signals.**

be said to be stable — two of these stable modes correspond to the two cycles (repeating groups) of states of three and five states respectively in length. The third corresponds to the single stable state — the state which recurs once reached. It can be seen that all other states, after a sufficient length of time, are ultimately drawn in to one of these stable areas of activity.

The crucial question which we now ask concerns the sort of state transition diagram which we might expect for any particular configuration of elements in the network. For example, suppose that we connect together in a totally random way a number of elements whose functions are selected completely at random from the set of all possible functions. How will this network behave?

Experimental results

In general terms, our intuition leads us to believe that a system whose specification is random will give rise to disorganised, unstable, possible chaotic, and certainly unintelligent behaviour.

For example, let us consider a parallel with the random network situation taken from everyday life. Suppose I arrange my filing cabinet in such a way that I allow some of Mr Jones' letters to be filed under 'S' and others under 'T', while Mr Brown's letters are put into a file marked 'Mr White' on odd days and a file marked 'Mr Green' on even days. Suppose that I further compound the disorganisation by putting all the P files in the A drawer, and so on. Surely I should not then expect my filing system to be even intelligible, let alone efficient!

To go back to the case of my random network of electronic cells, I should expect the randomness of the situation to give rise to unstable and unintelligible activity in the network, such random behaviour being characterised by the existence in the state diagram of many long strings of meaningless states and cycles containing a large number of states.

It is at this point that a surprising, but most interesting and highly significant, observation can be made. In a large number of experiments on many different networks it has been found in practice that rather than the unstable chaos one might expect, a random network exhibits highly stable and ordered behaviour, represented by the existence of very few repeating cycles of states, each cycle in itself comprising very few states. For example, a random network of 100 electronic cells — with the potential for existing in any one of 2100 states — was found typically to generate only about 10 cycles, each consisting of no more than about 10 states.

After a sufficient length of time the network will be found to exist in one of only relatively few state cycles, we may say that the system has a restricted and manageable number of different modes ▶

Input 1	Input 2	Output															
		f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8			f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Table 2: **All sixteen possible functions for a cell with two inputs.**

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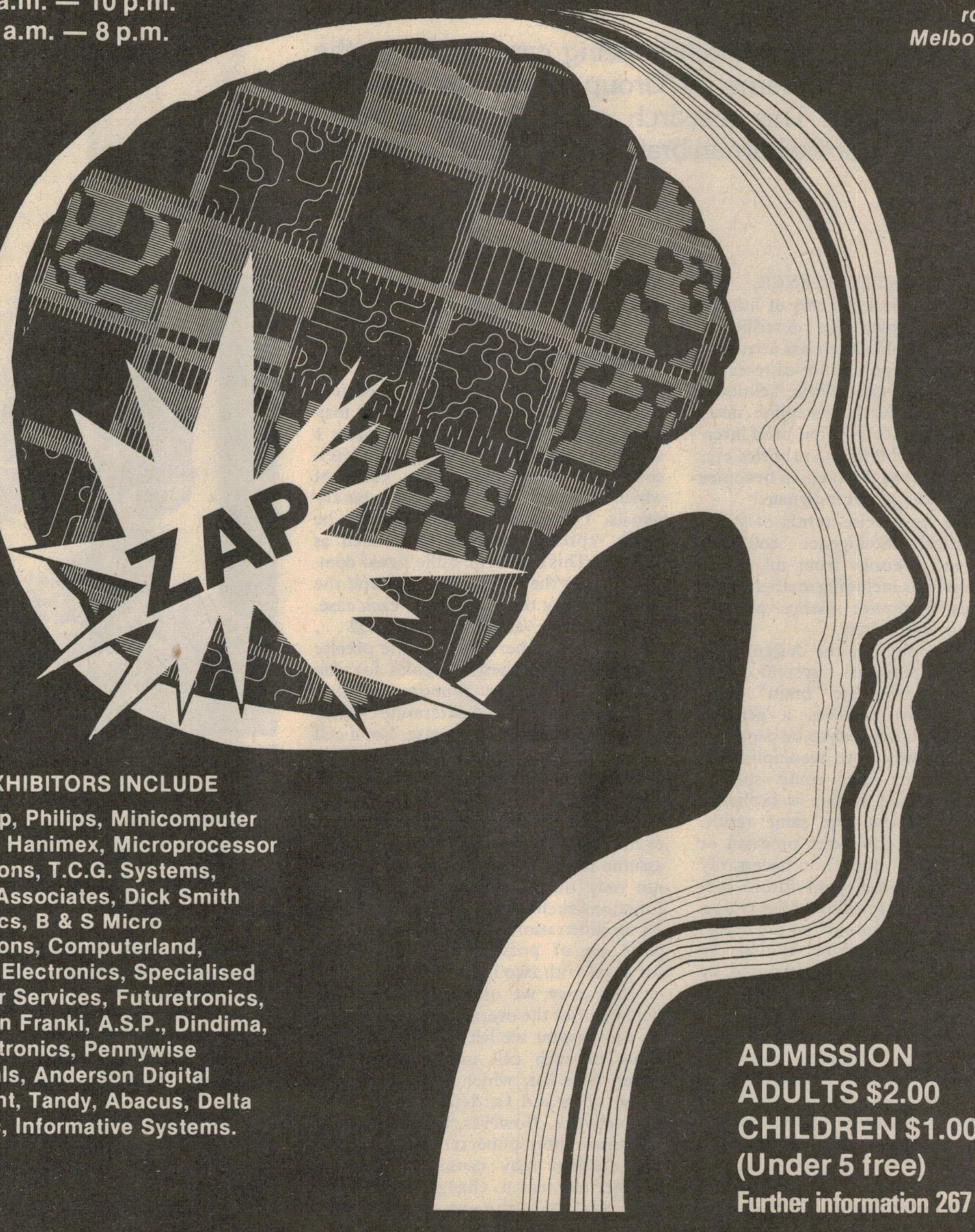

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Artificial intelligence — closer than you think

M.C. Fairhurst

Some very exciting research is being carried out by the Computers and Cybernetics Group at the University of Kent in England. This research could lead to a better understanding of the human brain — or a better computer.

ARTIFICIAL INTELLIGENCE, the imitation by artifical systems of human characteristics which we describe as intelligent, is a field which has attracted an increasingly large amount of research effort in recent years. While acknowledged as an academic discipline now, artificial intelligence is often used interchangeably with bionics , robotics etc, with the result that the layman becomes confused and the purist indignant!

Whatever its precise terms of reference, artifical intelligence embraces concepts and theories from many different disciplines including mathematics, cybernetics, computer science, psychology, biology and others.

The philosophy for the design of an artifically intelligent system (for example, to provide the "brain" of an industrial robot) requires a general-purpose digital computer to be programmed in such a way as to accomplish the desired task, or that some special-purpose computing system is explicitly designed to achieve the same result.

While such a computer program or electronic design does not necessarily preclude the possibility of future self-programming or adaptation of behaviour, the essence of this approach to the design of an intelligent machine is that the "intelligence" is somehow imposed by means of external intervention or manipulation.

This is by no means the only design philosophy. An alternative approach becomes immediately attractive if it is recognised that certain types of system possess inherent, as opposed to externally-imposed, intelligent characteristics. The problem of constructing an intelligent machine or robot then becomes one of exploiting these existing characteristics in a meaningful way rather than one of creating them.

Intelligence from chaos?

Let us look for an example of intelligent behaviour in what, at first sight, may seem to be an unlikely situation. Figure 1 shows a network made up of interconnected electronic cells, each of which receives and generates binary signals. The operation of a cell may be easily represented by a table such as Table 1. This lists all possible signal combinations at the input of the cell and the corresponding output signal in each case. Note that the variables Q0, Q1, Q2 . . . can each be either 0 or 1. The precise values given to these variables for any element define the *function* of that particular element and determine exactly how the element will operate. For a cell with K inputs there are exactly 22K different functions which could be defined.

The electronic cells described are examples of logic gates, although here we assume that any function may exist and not only the more usually-encountered functions such as AND, OR, NAND etc. As an illustration, Table 2 shows a complete set of possible functions f0-f15 for a cell with two inputs.

How may we usefully describe the behaviour of the overall network of cells? At any instant we list the output signal value of each cell in the network in order. This list, which will consist of a string of 0s and 1s, defines the *state* of the network. However, because the elements are interconnected the output of one element may cause the input to another element to change, while this in turn may cause the output of the next

The author of this article, Mr M.C. Fairhurst of the University of Kent.

cell in the chain to change, and so on. In other words, at successive instants the state of the network may change.

After a sufficient length of time, because there are a limited number of possible states which exist (000 . . . 00, 000 . . . 01,000 . . . 10, . . ., 111 . . . 11), a state or a group of states must repeat. We can summarise the network behaviour by drawing a *'State transition diagram'* which shows the changes from one state to the next in the network at successive instants in time. Part of one such state diagram is shown in Figure 2.

Note that in order to get a general picture of what is happening in the network it is not necessary to label each individual state at this stage. We can see that, in this example, the network has just three modes of activity which may ▶

Computer housekeeper

At the Chicago Consumer Electronics Show in June, Ohio Scientific added a large number of interesting peripherals to a home computer to show that it was capable of controlling a home.

The C8P DF is a conventional top of the line machine, with colour high-density graphics and twin 200 mm (8-inch) floppies. The points of interest were that it had a 'mainframe' architecture with slots available for further addition of Ohio Scientific boards, and the inclusion of 'home' peripherals.

The computer was connected to a mains-borne signalling device which enabled it to turn lights on and off, operate dimmers and receive signals from a security system including smoke detectors, door contacts, etc.

The system also has the ability to phone the police or fire services and tell them the trouble via a voice synthesiser!

Other features include the ability to answer telephone calls, a real time clock and monitor facilities which can be run in 'background' while the machine is operating as a terminal.

The suggested retail price is US $2597, and further information on it can be obtained from Systems Automation P/L, 26 Clarke Street, Crows Nest, NSW 2065; (02) 439-6477.

Brisbane TAFE courses to continue

The courses on microprocessor topics which the Brisbane IREE Microprocessor Interest Group have organised in conjunction with Queensland TAFE colleges, are to continue with a new series beginning early in September.

The fee for a ten-week course is only $14, and the Group make no profit on the deal.

It is expected that courses will continue in similar format next February.

Applications should be made by phone or in person to TAFE office, Old South Brisbane Town Hall, corner of Vulture and Graham Sts., South Brisbane, phone (07) 224-7847 or 224-7839.

Melbourne show draws near

The Melbourne Home Computer Show is on the horizon. Like the Sydney show, it will feature all manner of home computer equipment — but the emphasis this time will be on small business applications.

The show will be held in the Exhibition Buildings from the 27th to 30th September — the times are: 27th, 10 am to 6 pm; 28th, 10 am to 8 pm; 29th, 10 am to 10 pm and 30th, 10 am to 8 pm.

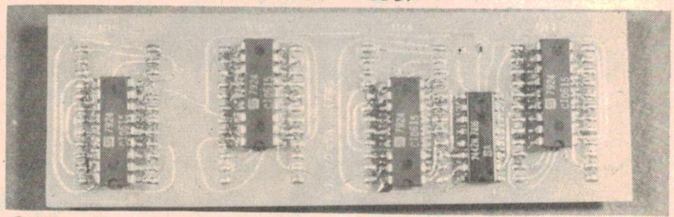
Admission charge will be $2 for adults, $1 for children (under-fives free). For further information, phone the organisers on (03) 267-4311.

Among the more interesting exhibits will be a Bridge Challenger from Futuretronics — similar in concept to their chess and backgammon machines. Hanimex will be showing a device called the 'Cyber Vision Computer', which uses two recorded tracks providing synchronised sound and graphics.

Dick Smith promises to provide a 'spectacular release' at the show. (Of icebergs? — Ed.)

Warburton Franki have said that they may be able to show a sample of the Heathkit Weather Computer, while Pennywise Peripherals and S.M. Electronics have announced an Australian 'first' — an electromechanical conversion which will allow computer control of a typewriter.

This could put us journos out of business altogether! Fellas, give us a break!



2K for the D2

The memory expansion board shown here can be used to increase the RAM of the Motorola D2 kit to 2K.

The board plugs into the four existing RAM sockets on the D2 kit, with one further connection completing the modification.

The memory appears in the field 0000 to 07FF, overlaying the existing RAM in 0000 to 01FF, so that any programs which ran with ¨K will still run under the new system.

The 2KD2 costs $39.95 (including post and packaging) and is available assembled and tested from Raydata, Box 477, Gosford, NSW 2250.

Crossed lines

In the August Printout we listed the 9900 Users Group with the wrong address. The place to send enquiries is: 9900 Users Group, GPO Box 835, Melbourne, Vic. 3001, phone (03) 661-2523 during office hours.

Apologies to Les Kinch, whose name was listed by mistake under 9900. He **does** run the TRS-80 group, however.

Business-oriented PET appears

A new version of the Commodore PET, with a more conventional keyboard, will be available shortly in Australia.

The machine will not have the internal cassette recorder of the earlier model, and the emphasis seems to be on a dual floppy disk drive to replace this.

The machine will be available in both 16K and 32K versions and, apart from the keyboard and cassette changes, will look very much like the original PET — it will have the same built-in VDU and a partial implementation of the IEEE-488 bus.

Commodore have also released a long-awaited twin floppy disk, with a 340K capacity. Also on the market are two dot-matrix printers — one tractor-fed type with programmable line spacings for form printing and a friction-fed unit for general-purpose printing with constant line spacing.

All of the above units are available from Electronic Calculator Discounts, PO Box 106, Baulkham Hills, NSW 2153, phone (02) 624-8849, 8 am to 3 pm).

TI home computer holds few surprises

The Texas Instruments home computer was released at the Chicago Consumer Electronics Show in June and brought disappointment from the public and relief from other manufacturers.

The yawns at the Chicago Show were over the price of the unit — US$1,150 — as many people remembered what TI did to the calculator and watch markets.

The price of the unit includes a 33 cm colour monitor. A cheaper unit, with an RF modulator, should prove more interesting to the amateur when it is released sometime in 1979.

The machine uses the 9900 16-bit processor with 16K of RAM and 26K of ROM. Plug-in modules carry up to 30K of ROM.

TI seem to be playing down the use of audio cassettes for program storage. Although the unit has I/O for two tape recorders, their press release describes this method as "time-consuming".

They promise a disk system later this year.

The video monitor output is interesting — the machine puts out composite audio and video information, with 16-colour graphics and a 32 character by 24 line display. There are 256 user-programmable characters.

One remarkable feature is the music output. This is fed to the monitor, allowing three simultaneous tones plus one noise source to be played, with variable volume and a four-octave range for each tone.

A speech synthesis module will shortly be available, giving a built-in volcabulary of about 200 words for US $150.

Computer chess championships

It's not often that ETI reports on a chess championship — but this one was a bit different. It was held at the Sydney Home Computer Show (See ETI July 79, p. 95) between four contestants:

Contestant 1: A TRS-80 level II with 16K, using a Sargon program.
Contestant 2: An Apple II level II with 24K, also using a Sargon program.
Contestant 3: A PET level II with 16K, using Microchess 2.0.
Contestant 4: A Chess Challenger 7 playing at level 7.
Altogether a very interesting contest. This is how it went:

The first day saw the PET draw white against the Chess Challenger. Unfortunately the PET program wouldn't allow it to play white and so the Challenger made the first move, gaining mate in 18.

Meanwhile, the Apple drew white against the TRS-80, and seemed rather excited at the prospect — it kept making illegal moves. However, with patient handling by its controller, it was convinced to play within the rules and went on to lose the game after 29 moves.

The second day was plagued by power fluctuations, which prevented the TRS-80 from loading its program. Other machines were having problems with the public — as each move took about three minutes to work out, many people thought that the machines were sitting there waiting to be played with! All of these problems culminated in the decision to make Day Two a rest day. No sooner had this been agreed than the TRS-80 got over its problems and a lull in the crowd allowed both games to get underway. Two hours and forty minutes after its second move, it was conceded by its controller that the TRS-80 was no longer thinking about chess and was possibly asleep. At the other match, the Apple II refused to recall an illegal move, so the day of rest was granted after all.

On the third day the general public were allowed in for the first time, days one and two having been for trade and schools only. Fortunately, all of the machines performed beautifully. The PET even learned how to play white and forced a resignation from the Apple in 67 moves.

The final results? Chess Challenger won, followed by the TRS-80 and then the PET. The Apple was scoreless.

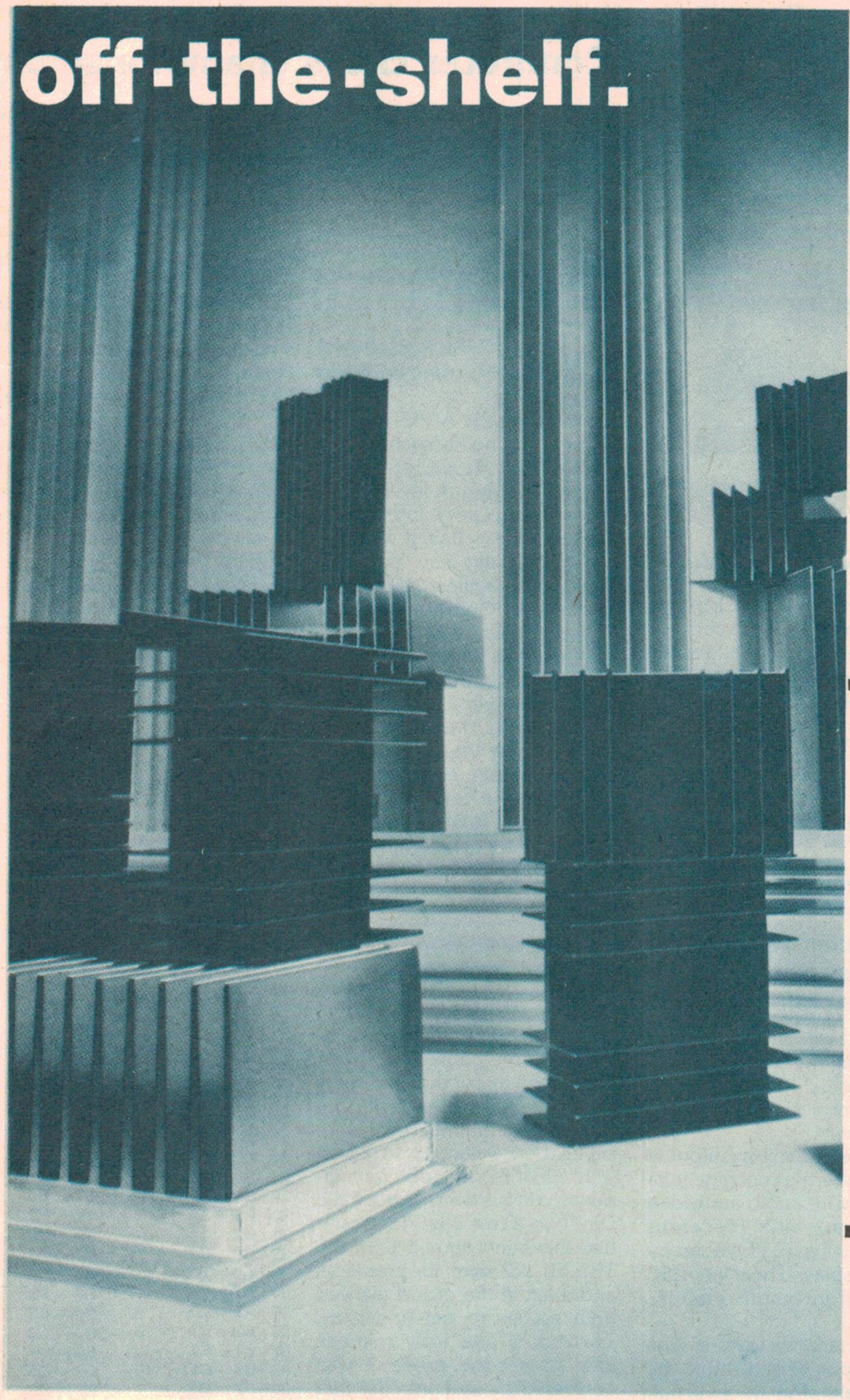
The following game, between the Chess Challenger and the Apple, shows the general standard of play. There are undoubtedly weaknesses in all chess programs (as indeed there are in all chess players) but the coming years will almost certainly see some improvements.

Round 3

	Apple 2 – White	CC7 – Black
1	E2 – E4	E7 – E5
2	B1 – C3	B8 – C6
3	G1 – F3	F8 – C5
4	F1 – C4	D7 – D6
5	C4 – B5	G8 – F6
6	D2 – D4	E5 – D4
7	F3 – D4	G5 – D4
8	D1 – D4	0 – 0
9	A5 – C6	B7 – C6
10	C1 – G5	G8 – G4
11	F2 – F3	G4 – E6
12	E1 – D2	C6 – C5
13	G5 – F6	C5 – D4
14	F6 – D8	D4 – C3
15	B2 – C3	F8 – D8
16	H1 – B1	D6 – D5
17	E4 – D5	E6 – D5
18	D2 – E3	D8 – E8
19	E3 – D4	A8 – D8
20	E4 – C5	E8 – E2
21	B1 – D1	C7 – C6
22	C3 – C4	E2 – G2
23	A1 – C1	G2 – H2
24	C4 – D5	C6 – D5
25	D1 – D5	D8 – C8
26	C5 – B4	H2 – F2
27	D5 – E5	C8 – B8+
28	E5 – B5	B8 – B5
29	B4 – B5	H7 – H6
30	B5 – A6	F2 – F3
31	C2 – C3	H6 – H5
32	C1 – C2	F3 – D3
33	A6 – A7	H5 – H4
34	A7 – B6	G8 – F8
35	A2 – A3	D3 – E3
36	C2 – C1	H4 – H3
37	C1 – C2	E3 – E6
38	B6 – C7	G7 – G5
39	C2 – D2	E6 – H6
40	D2 – D5	H3 – H2
41	D5 – D8+	F8 – G7
42	D8 – D1	G5 – G4
43	D1 – H1	G4 – G3
44	A3 – A4	G3 – G2
45	H1 – E1	H2 – H1 = Q
46	E1 – H1	G2 – H1 = Q
47	A4 – A5	H1 – C6+
48	C7 – B8	H6 – H8+
49	B8 – A7	H8 – A8 mate

Heatsinks

Electronic
Components
and Materials,



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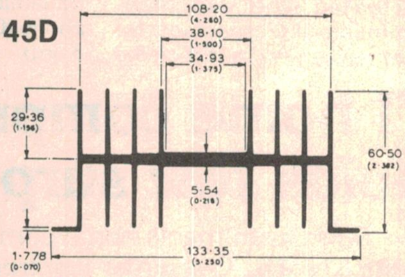
36 and 72 inch lengths, bulk lengths, and the 65D series come in mill finish; the others are black anodised.

TYPE	2"	3"	4"	6"	8"	36"	72"
35D	*	*	*	*	—	*	*
40D	—	*	*	*	—	*	*
45D	—	*	*	*	—	*	*
55D	*	—	*	*	*	*	*
65	—	—	*	*	*	*	*

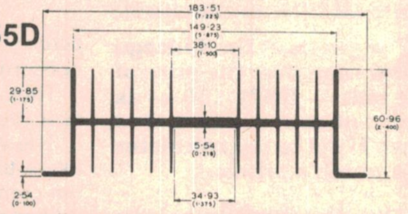
SAMPLE EXTRUSION PROFILES

45D



Dimensions in mm.
Inch conversions in brackets.
Scale 1:2

55D



For further information, contact Philips Electronic Components and Materials, or their Distributors.
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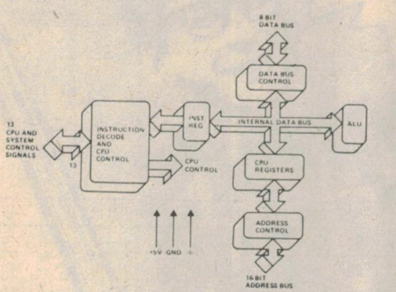

Fig. 1 CPU BLOCK DIAGRAM

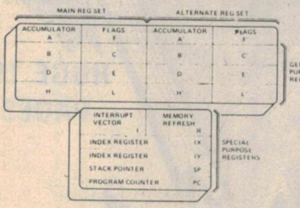

Fig. 2 CPU REGISTERS

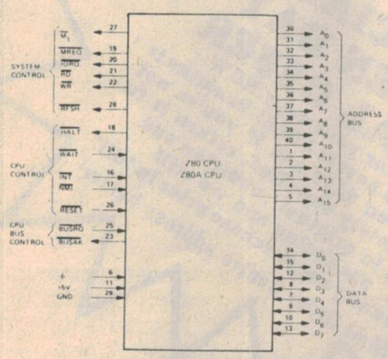

Fig. 3 PIN DESCRIPTION

Figure 1 is a block diagram of the CPU, Figure 2 details the internal register configuration which contains 208 bits of Read/Write memory that are accessible to the programmer. The registers include two sets of six general purpose registers that may be used individually as 8-bit registers or as 16-bit register pairs. There are also two sets of accumulator and flag registers. The programmer has access to either set of main or alternate registers through a group of exchange instructions. This alternate set allows foreground/background mode of operation or may be reserved for very fast Interrupt response. Each CPU also contains a 16-bit stack pointer which permits simple implementation of multiple level interrupts, unlimited subroutine nesting and simplification of many types of data handling.

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Features

- Single chip, N-channel Silicon Gate CPU.
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The Z80 Family of Components & Technical Manuals are now available at: **SILICON VALLEY** and **COMPUTERLAND** stores throughout Australia; **PROTRONICS**, Adelaide; **NS ELECTRONICS**, Brisbane; **ZERO ONE ELECTRONICS**, Brisbane.

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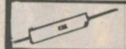

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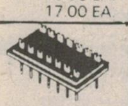

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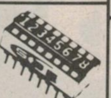

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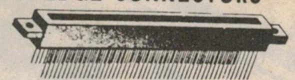

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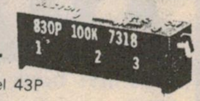


Spectrol Model 43P

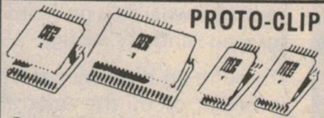
ACTUAL SIZE

STOCK VALUES

10, 20, 50, 100, 200, 500, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M 1—9 **$1.10**

Values may be mixed 10+ **$0.98**

PROTO-CLIP



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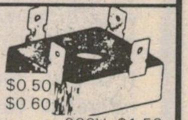

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Two new amateur books

Two new books came to hand last month that are aimed at the amateur-in-the-making.

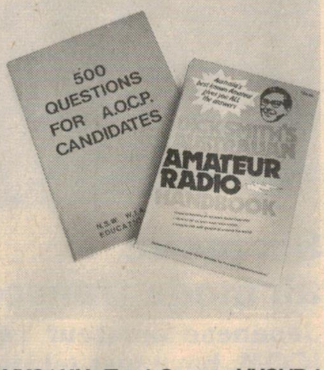
First up is a modest little production from the NSW WIA Division's Youth Radio Service, Education Service. Titled "500 Questions for AOCP Candidates" it consists of a set of theory questions to aid students studying for the full amateur licence. The examination for the AOCP certificate will be changed to a "multiple-choice" format shortly and the book presents a set of questions under twelve sections or topics, covering the required theory.

A proposed syllabus is also included, and the authors indicate that it is likely to be close to the final syllabus to be approved by the P & T Department.

The text is clear and well set out. Diagrams are used quite liberally and, though a little rough, seem clear enough in general. They are certainly adequate for the job. Unfortunately, they suffer through the use of non-standard symbols which may cause some confusion with students.

Overall, it should be a very useful book to students studying for the AOCP.

"500 Questions . . ." was compiled by Bill Dunn, VK2BDW, Ken Hargreaves VK2AKH, Fred Santos VK2YBJ and Dave Wilson VK2ZCA/NMW. The book measures 165 mm by 237 mm and contains 96 pages inside a stiff card cover. It is obtainable from The WIA (NSW Div.), 14 Atchison St, Crows Nest NSW 2065.



The second book is "Dick Smith's Australian Amateur Radio Handbook". Unfortunately, it arrived too late for us to do a review — but we are interested in readers' comments.

The book has 15 chapters plus appendixes, 192 pages and stiff cover and costs $6.95 through Dick Smith Electronics stores.

Clubs

The active and enthusiastic Geelong Radio and Electronics Society held their Annual General Meeting recently, electing the following office bearers:
President: A. Chalmers VK3NOR
Vice-Pres: R. Tippett VK3NMF
Secretary: R. Francis
Treasurer: W. Erwin VK3WE

Another six were elected to the General Committee and a further four as Special Officers. The office bearers will remain in office for two years, as required by the new constitution.

The Club's printed circuit board equipment is used a lot and the addition of materials and facilities for members to produce their own artwork and negatives has created even further interest. Project building activity is running very high at present.

Novice and advanced classes (free to enrolled members) are run on Monday nights from 1900 to 2100 hours.

The Society's rooms are located at Belmont common in Geelong. You can contact the club at P.O. Box 962, Geelong, Vic., or phone 9-3337 or 21-3658.

"Amateur Radio Weekends" are for those with a keen interest in electronics, computers and communications — beginners through to 'old hands'.

These weekends are run by a number of clubs as an education service. Three are planned for the last quarter of this year.

Each weekend is the same, consisting of a series of lectures and demonstrations. They run from Friday night to Sunday afternoon. Costs are low, adults $22 — partners not attending lectures $15; school students $15; children 10 and under $8.

Weekend at Wagga commences Friday 12 October and runs to Sunday 14th. It will be held at the NSW Sport and Recreation Centre on the Sturt Highway. For bookings, contact: The Education Officer, Wagga Amateur Radio Club, 110 Simkin Cr, Wagga 2650 or phone Bruce VK2VKZ on (069) 22-6747.

Weekend at Springwood starts Friday 2 November. It will be at the Blue Gum Lodge Youth Centre in Springwood in the Blue Mountains. Bookings to: Amateur Radio Weekend, WIA Education Service, P.O. Box 52 Asquith 2078 or phone Sel VK2NOK on (02) 827-3589 or Ken VK2NWK on (02) 638-1687.

Weekend at Port Macquarie commences Friday 9 November at the Wauchope Showground hall. Bookings to Oxley Region Radio Club, P.O. Box 712 Port Macquarie 2444 or phone Frank VK2NUG (065) 83-1256.

Double oops!

Pardon our slip showing, but in the two transceiver reviews featured last month, the IC-701 and Atlas Tx/Rx 110, the measured SSB power output in each case was in error.

Shown as 50 W, each should read 100 W PEP instead.

Increase your word power now!

Great circle map

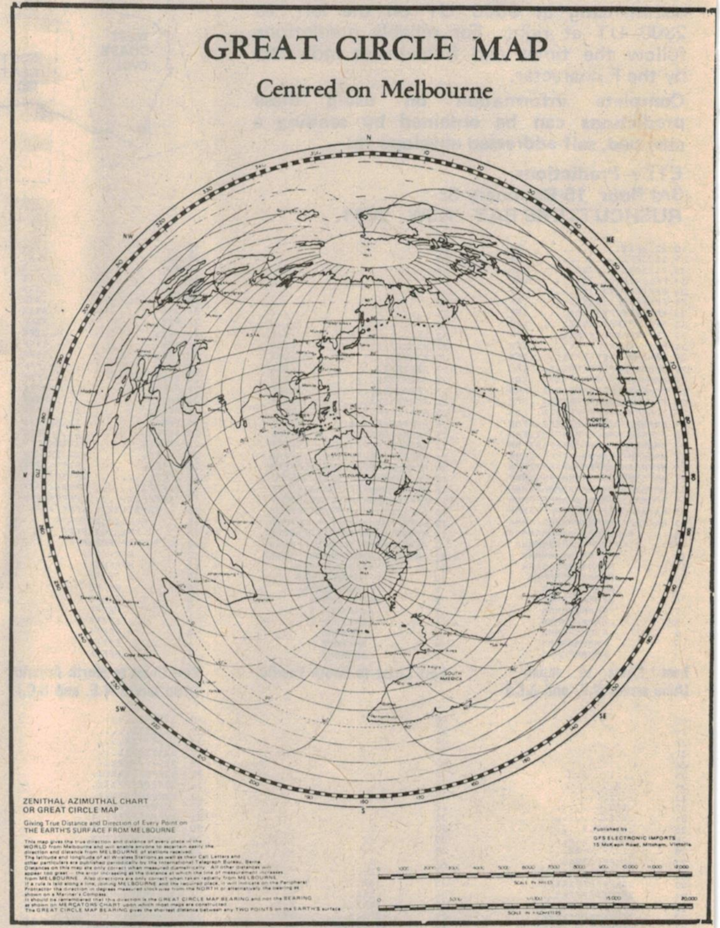
Published recently by GFS Electronic Imports of Melbourne, this map will be very useful to amateurs and shortwave enthusiasts located in the southern states.

The map is a special type of projection that enables one to determine the true bearing and distance between the map's centre point and any other place on the earth's surface.

The map is centred on Melbourne. By laying a rule along a line joining Melbourne and the required place, the true bearing may be read from the peripheral protractor — marked around the outer circle of the map. The great circle distance — that is, the shortest distance — between Melbourne and the required point may also be scaled from the map.

This is of great assistance in determining where to point a beam antenna to obtain contact with another country or listen for shortwave stations.

The map measures 335 mm by 430 mm and is obtained for $1.75 posted from GFS Electronic Imports, 15 McKeon Rd, Mitcham, Vic. 3132 (03) 873-3939.



Don't forget!

The 1979 F.A.C.T. Symposium is being held over the weekend of 29-30 September — 1 October.

Radio amateurs and communications enthusiasts should not miss this one. The 1978 Symposium was the amateur event of the year.

Venue is the salubrious Noah's Northside Gardens Hotel in North Sydney where you can enjoy a stimulating round of lectures and discussions on topics ranging from the solar peak to amateur microwaves. For a registration fee of only $20 you can participate — lunches, morning/afternoon teas and a copy of the 'Proceedings' all included.

A Symposium Dinner has been organised for the Saturday night. For a modest sum you (and your partner) can join in the Symposium's social highlight and get together with long-time associates, or make new friends from the enthusiasts gathered there.

Accommodation is available at reduced rates for attendees who require it.

For more information, see the advertisement this issue or write: The FACT Symposium Organiser, c/o ETI 15 Boundary St, Rushcutters Bay 2011 NSW.

Don't forget!

World distance record for six metres broken

The world record distance for a contact on the six metre amateur band, unchallenged for more than 20 years, now stands at 19 300 km (12 059 miles).

The record was broken early in March this year by HL9TG (Korea) and LU8AHW (Argentina). HL9TG operates from Pyong-Taek, running a Heath SB110 into a five element yagi antenna.

International CB

The European Citizens Band Federation has proposed a set of guidelines for the establishment of an international CB service.

They plan to have the proposals considered at WARC being held in Geneva this month and next.

The Federation propose six bands at 6 MHz, 13 MHz, 27 MHz, 40 MHz, 49 MHz and 900 MHz.

They also propose a slow-scan television CB service to enable CBers to swap picture transmissions internationally as many radio amateurs do at present.

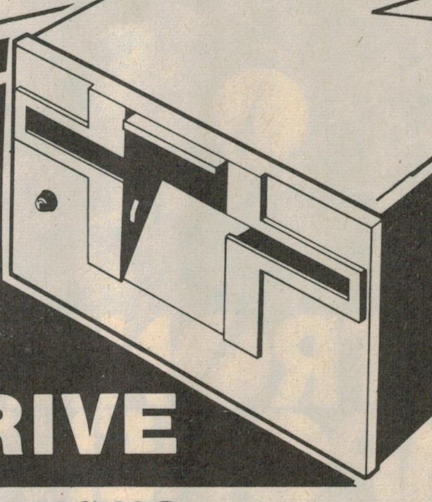
One wonders what they think amateur radio is for.

Donation to WIA WARC fund

The Wireless Institute of Australia received a donation of $500 from Dick Smith Electronics towards their effort to send a delegate to the World Administrative Radio Conference that commences in Geneva on the 24th of this month.

Shown in the picture is Dick Smith's Melbourne store manager 'Mac' McCallum accepting a receipt for the donation from Federal President of the WIA, David Wardlaw VK3ADW.

TRS-80 OWNERS: READ THIS AND SAVE A FORTUNE



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DON'T PAY ~~$689.00~~

SPECIAL INTRODUCTORY PRICE $379.00 INC TAX

POWER SUPPLY $60.00 INC TAX

HERE'S WHAT YOU CAN SAVE:

NUMBER OF DRIVES:	FIRST DRIVE	2ND DRIVE	3RD DRIVE	4TH DRIVE
MINI DISK DRIVE (Cat X-3230)	$379.00	$379.00	$379.00	$379.00
POWER SUPPLY UNIT (Cat X-3234) (Powers one or two drives)	$60.00	N/A	$60.00	N/A
WIRING HARNESS (Cat X-3232) (Connects up to 4 disk drives)	$49.50 (Or do it yourself)	N/A	N/A	N/A
DOS DISKETTE (available from Tandy)	$19.95	N/A	N/A	N/A
TOTAL COST OF DICK SMITH SYSTEM	**$508.45**	**$379.00**	**$439.00**	**$379.00**
TOTAL COST OF TANDY SYSTEM:	$699.00	$689.00	$689.00	$689.00
YOU SAVE:	**$190.55**	**$310.00**	**$250.00**	**$310.00**

So if you buy a 4 drive system from Dick Smith you save a massive **$1060.55** plus you get 49k extra memory!

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SEE OUR OTHER ADVERTS IN THIS MAGAZINE FOR OUR STORE ADDRESSES AND RESELLERS

ELWA, P.O. Box 192, Monrovia, Liberia

Located in West Africa about 10 degrees north of the equator, ELWA, the radio voice of the Sudan Interior Mission, broadcasts in 40 languages to Africa and the Middle East.

Congo beat

Radio Brazzaville recently introduced two new shortwave channels.

The station has moved from the long-established outlet of 4765 kHz, to a new 90 metre channel of 3265.

Also new is 3255, replacing 3232, and this is the lower powered Brazzaville transmitter running four kilowatts.

The 50 kilowatt unit is used on 3265 and this outlet offers best reception in Australia between 2000 and 2200, with programmes in French.

There is also a news roundup from Brazzaville in English, usually heard at 2130-2145, although the timing of the English segment sometimes varies.

Kampuchea back on the air

After some months absence during the continuing conflict in this country, Phnom Penh radio is again active on shortwave.

Programmes in Khmer may be heard every night at 9695 between 1100 and sign-off at 1300, while the parallel outlet of 11 945 is heard when New Zealand clears the frequency at 1215, until 1300.

The station was due to start a Foreign language service in July, however this has not as yet been observed as we go to press.

The monitoring service of the BBC says the station intends having English programmes every day in four segments of 15 minutes each, timed for broadcast on the above frequencies at 1200, 1300, 2300, and at 0000 (midnight GMT).

NOTE! All times are given in Greenwich Mean Time (GMT). To convert GMT to Australian Eastern Standard Time, add 10 hours. To convert to Central Time, add 9 hours, and for Western Time, add 8 hours. All frequencies are in kHz.

Compiled by Peter Bunn, on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from either PO Box 67, Highett, VIC 3190, or from PO Box 79 Narrabeen, NSW 2101, for a 30c stamp.

Brazil continues English service

Radio Nacional at Brasilia continues its International Service, with three daily programmes in English.

The new schedule shows these services at 2000 to 2100 on 15 270, 2105-2200 on 15 280, and at the new time of 0300-0400 on 15 290.

Interesting programmes include "Events in Brazil" every Tuesday and Saturday, plus the weekly "News Review" from Brasilia in the Sunday programme.

Afghanistan in English

Kabul has recently re-timed the English programme, which is now heard at the later time of 1530, on 4775. Radio Afghanistan also has a second English program, at 1900-1930, and the latest observed outlet for this programme is 15 075.

Venezuela station on new channel

The well known station in San Cristobal, Ecos del Torbes, has recently reactivated its 49 metre outlet of 6190.

This may be heard from 1000 in parallel with Ecos del Torbes' 60 metre channel of 4980, and both outlets provide excellent reception in east Australia. Sign-on time is sometimes as early as 0900.

Andorra broadcasts

The commercial broadcaster, Radio Skandinavia, is currently scheduled for broadcasts via the shortwave outlet of Radio Andorra on the 1st Sunday (GMT) of each month from 2100 until 2145.

Radio Skandinavia will continue these transmissions until October this year, in Swedish, Danish and English, on 6215.

Meanwhile, Radio Andorra has advised the World Radio and TV Handbook that it plans to upgrade its shortwave transmitter to 10 or 20 kilowatts, with a new log periodic antenna.

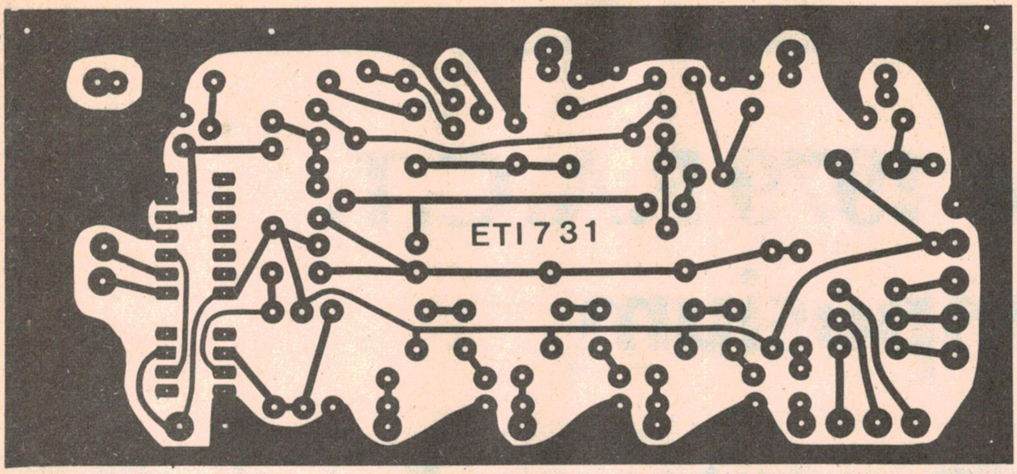
The present transmitter can only operate on either 6215 or 6230.

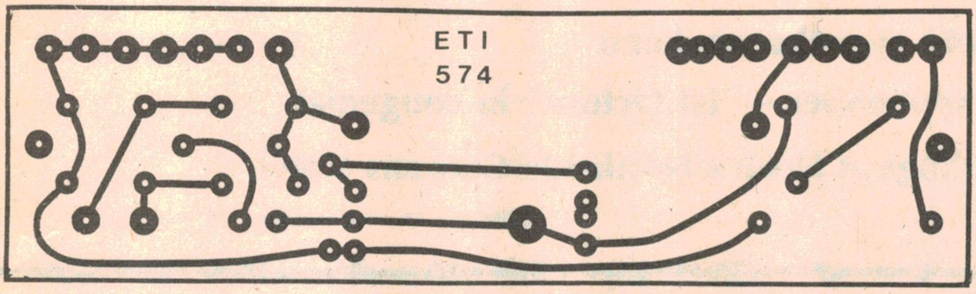
Voice of Asia on shortwave

The Voice of Asia has for some time been broadcast on mediumwave via the facilities of the Broadcasting Corporation of China (Taiwan) in Taipei.

Now the station may be heard on shortwave as well. The frequency is 5980, and programmes include English Monday to Saturday 1100-1200 followed by Indonesian, then Chinese from 1300 and Thai 1500 to the 1600 sign-off.

Reports may be sent to Voice of Asia at PO Box 880, Kaohsiung, Taiwan.





Using ETI PCB Artwork

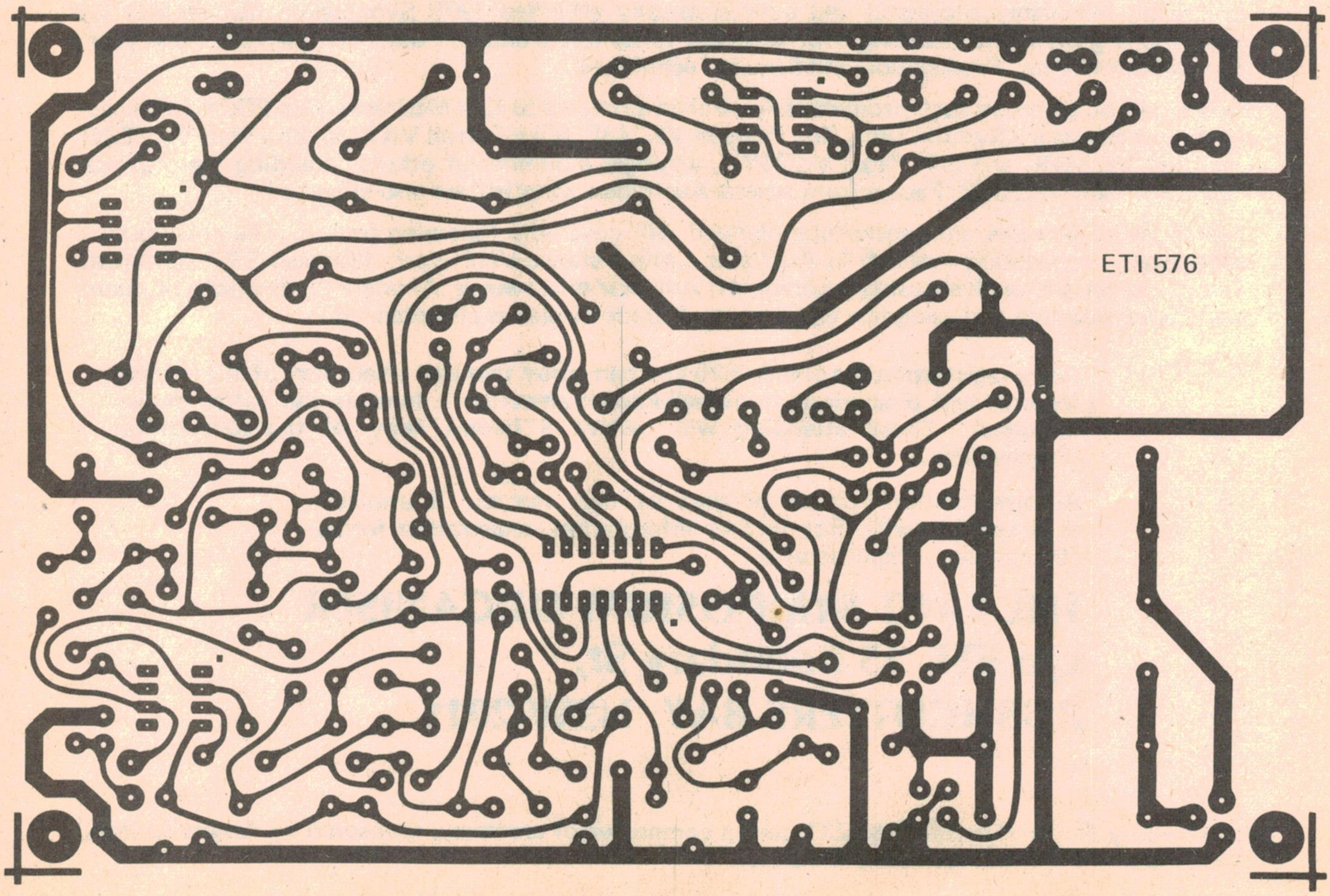
This method can be used to make negatives of ETI artwork from October 1977 on, provided the reverse of the page is printed in blue. The film used is Scotchcal 8007 which is UV sensitive and can be used under normal subdued light.

Cut a piece of film a little larger than the pc board and expose it to UV light through the magazine page. The non-emulsion side should be in contact with the page. This surface can be detected by picking the film up by one corner — it will curl towards the emulsion side. Exposures of about 20 minutes are normally necessary.

The film can now be developed by placing it emulsion side up on a table, pouring some Scotchcal 8500 developer on the surface and rubbing it with a clean tissue.

Further information on Scotchcal and pcb manufacture can be found in the September and December 1977 issues of ETI.

Please note that occasionally lack of space may prohibit the printing of blue type behind all pcb's. In this case the reader must resort to more conventional photographic techniques for pcb manufacture.

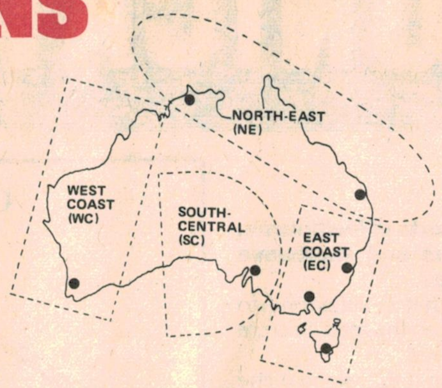


PREDICTIONS OCTOBER 1979

Covering 3 to 40 MHz, these predictions show the times radio contact is possible between the areas designated beneath each graph, as well as the possible 'mode' and reliability. Vertical columns indicate time — commencing at 0000 UT on the left, to 2300 UT at right. For reliable predictions follow the times and frequencies indicated by the F character.

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:-

ETI — Predictions
3rd floor 15 Boundary St
RUSHCUTTERS BAY NSW 2011.



These GRAFEX style computer generated predictions are provided courtesy of the Australian Ionospheric Prediction Service.

KEY TO SYMBOLS

A blank area means no normal propagation is possible.

% . . . . path open 50 - 90% of days in month.

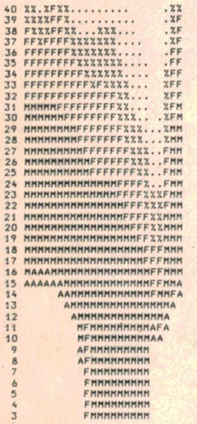
F . . . . path open at least 90% of days in month.

B . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

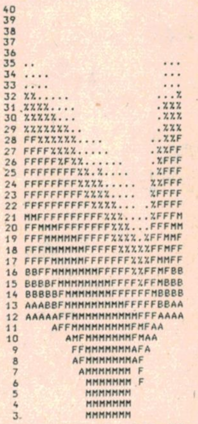
M . . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

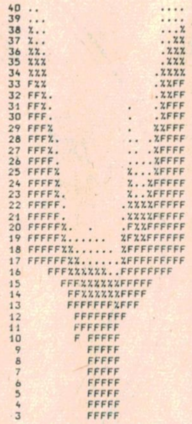
A . . . . High absorption indicated. Expect weak signals.



East Coast to Japan (Also serves N.E. and S.C.)

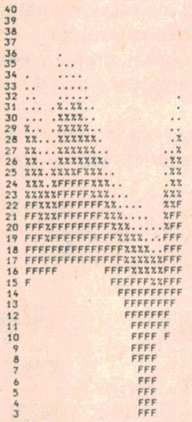


East Coast to South Pacific

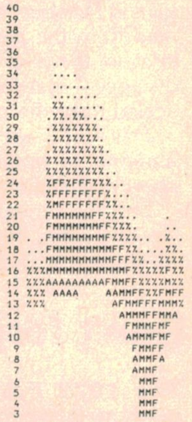


East Coast to North America (Also serves N.E. and S.C.)

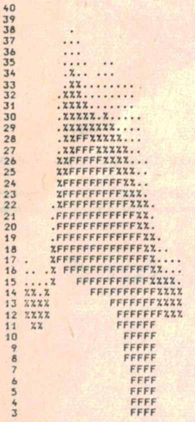
East Coast to South America (Also serves S.C.)



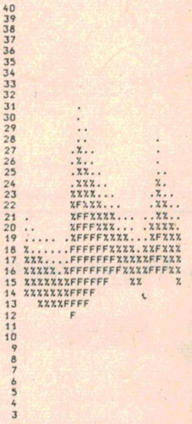
East Coast to North Africa (Also serves S.C.)



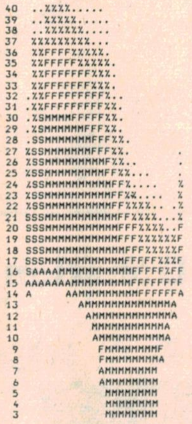
East Coast to South Africa (Also serves S.C.)



East Coast to Europe (Short Path)



E.C. and S.C. to Europe (Long Path)



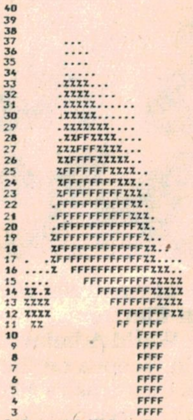
East Coast and S.C. to Persia

North East to South Pacific (Also serves S.E.)

North East to North Africa

North East to South Africa

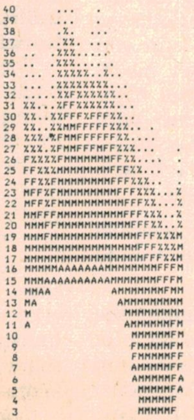
North East to Europe (Short Path)



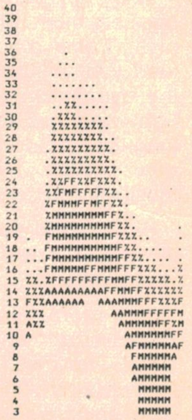
S. Central & W.C. to Europe (Short Path)

West Coast to North America

West Coast to Japan



West Coast to North Africa



West Coast to South Africa

Third World pressure on satellite allocations

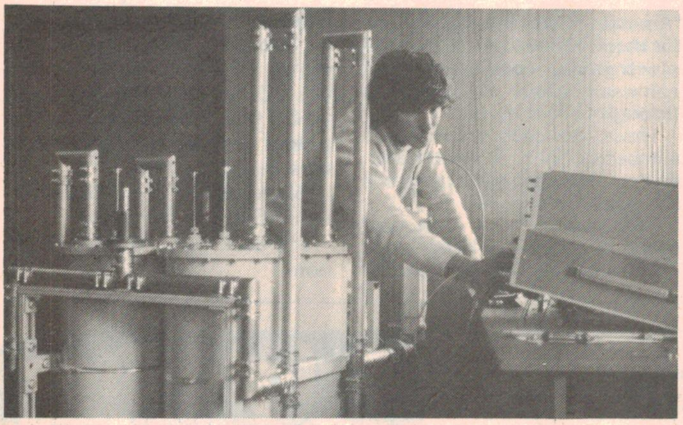
A group of Third World nations, including India and central African nations, are opposed to a US proposal to be put up at WARC in Geneva to parcel out a fixed share of the microwave spectrum to each country, a scheme that favours the introduction of privately run satellite communications systems.

Under the proposal, each country would have a fixed share of the microwave spectrum and thus a strictly limited number of frequencies for satellite services.

Opposition has come from Algeria, Cuba, Yugoslavia, India and a group of central African nations. They are pressing for a "fair shares for all" plan for satellite point-to-point communications as already exists. Their opposition poses a threat to such privately-owned satellite schemes as Satellite Business Systems (an IBM venture) and another by Xerox.

They argue that, at present, the industrialised world — led by the US — has the biggest share of the satellite frequency bands merely because it devised the technology to exploit them before anyone else.

The US schemes propose a satellite system in which business users could have the benefits of satellite communications from roof-top antennas and terminals.



Diplexers for VHF systems

Spacings of low band VHF transmit and receive frequencies as close as 800 kHz created the need for diplexers capable of reducing severe transmitter and receiver interaction.

Model 2P4-2N70 diplexer was developed by Antenna Engineering Australia Pty. Ltd. to provide the isolation necessary.

This diplexer — new designation CP70-422N — provides receiver protection from the transmitter frequency overload and transmitter noise of 90 dB for an insertion loss of 1 dB, AEA claim.

A model providing 125 dB isolation has also been released, the CP70-432N.

For the VHF high band (148-174 MHz), AEA has developed similar diplexers. These will allow transmit to receive spacings as close as 600 kHz and will give protection of 90 dB or 125 dB depending on the model selected.

Contact Antenna Engineering Australia Pty Ltd, Garden Street, Kilsyth, Vic. 3137; phone (03) 728-1777.

Six metre all mode transceiver

Japanese amateur equipment manufacturer, ICOM, have just released the export version of their 6m, all mode transceiver.

The IC511 as it is called, follows in the tradition of the IC211 (2m) and the IC701 (HF) in that it is the same size and appearance but with increased facilities.

The IC511 covers 50-54 MHz and the export versions for Australia will have the optional FM and passband tuning units installed. Modes covered will be FM, SSB, AM and CW with the dual VFO system as used in the IC211 and 701, part of the package. Memory is provided (three frequencies) and a scanning function with variable speed can be switched in to cover the whole band.

The usual features of VOX, RIT, Squelch, noise blanker, CW monitor, common to other units in the Icom range, are standard equipment.

An unusual aspect of this ac/dc rig is the power module which uses a high frequency inverter which has the advantage of eliminating bulky power transformers.

The proven optically-encoded disc tuning circuit is employed, enabling interface to commercial microprocessor chips. Three internal processors are used for tuning and PLL functions.

Power output is a nominal 10 watts. It seems the IC511 continues the innovative technical and performance tradition of other units in the Icom line.

Price is expected to be around $800 and enquiries on availability should be directed to the Australian distributors, Vicom International Pty Ltd, 68 Eastern Road, South Melbourne, phone (03) 699-6700.

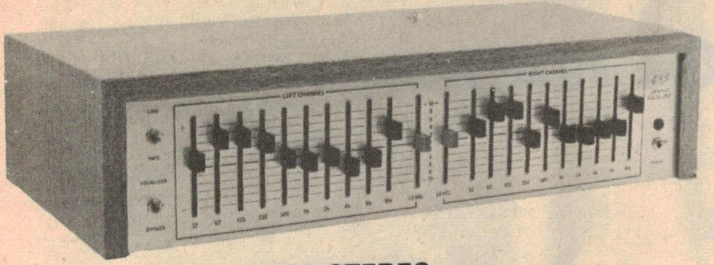
Phase III OSCAR will have role in personal computer networks

Scheduled for launch next March, the Phase III OSCAR will carry what is described as ". . . the world's first space-bound microcomputer".

The satellite will make it possible for personal computer networks to be set up on a global scale. If it lives up to its promise, the Phase III OSCAR could steal the march on the large data communications satellite projects — such as the Satellite Business Systems venture in which the computer giant, IBM, has a stake.

Design, construction and launch of the OSCAR series of satellites is co-ordinated and funded by the Amateur Satellite Corporation, AMSAT, an independant body of radio amateurs whose aim is to stimulate and promote amateur use of space.

SPECIAL OFFER ON TWO OUTSTANDING KITS

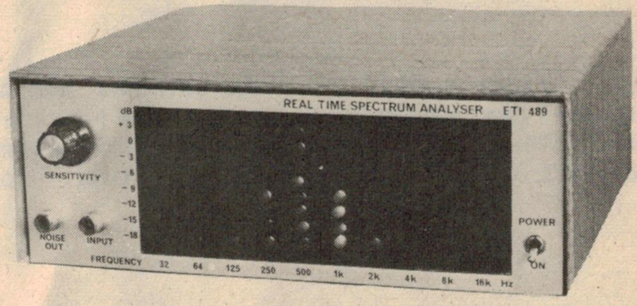


The special offer on these two kits has been extended for one month for all those who missed out because of the mail strike.

485 STEREO GRAPHIC EQUALISER

Not only do you get a stereo ten band equaliser, but also a ten-band analyser with LED display, to enable accurate adjustment of your system.
No longer need you rely on your ear to set up the equaliser. With the analyser connected you see at a glance if your system is correctly equalised.

489 AUDIO SPECTRUM ANALYSER



BUY THE TWO FOR LESS THAN THE PRICE OF A COMMERCIAL EQUALISER

Complete Kit 485 Equaliser (P&P $3.00)
$102.60 tax free
$118.00 tax paid
Complete Kit 489 Analyser (P&P $3.00)
$123.48 tax free
$142.00 tax paid
Buy the two together for only:
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(P&P $6.00)

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4 Pole	7401	on/none/on	3.91
2 Pole	7203	on/off/on	1.87
2 Pole	7205	on/off/mom	2.25
2 Pole	7207	mom/off/mom	3.13
2 Pole	7211	on/on/on	2.78
1 Pole	8534	Push to break	1.25

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Mixed values 100 off..................................$3.00
All one value 100 off..................................$2.00

These are the off-the-shelf prices.
All preferred values stocked.
Only quality resistors stocked.
NO MINIMUM INVOICE VALUE:
NO WAITING — off-the-sheld service. Yes, we have all preferred values.
1 watt, 5 watt & 10 watt all preferred values in stock. **Sorry, no mail orders — personal shoppers only.**

DEE WHY 982-7500

Pioneer introduced the PL-L1000 tangential arm turntable at the CES. This uses a unique linear motor system to drive the arm assembly.

CE Show highlights

Sources

This year has seen more advance in cassette deck technology than in any other part of the hi-fi field. The introduction of metal alloy tapes has brought a rush of new decks.

Noise reductions systems were fairly quiet this year (sorry! — Ed), only major contenders being the Adres system (see ETI July) and a new dbx lineup. Nakamichi's Hi-Com II system was not ready for this year's show but should be released shortly.

Maxell unveiled their new range of cassette tapes, which use a new formulation — gamma ferric oxide and cobalt-ferrite. Maxell have dubbed this an EPITAXIAL material.

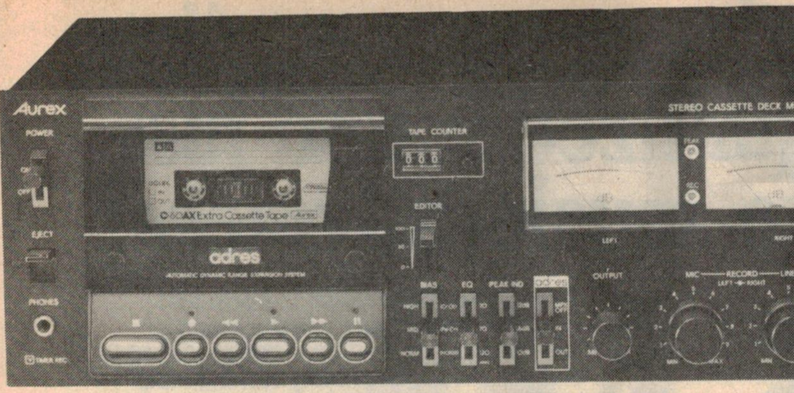
Direct drive seems to be the coming thing in turntables, with Pioneer bringing in a new range of budget models and with new releases from Sanyo, Technics and others.

Direct-drive was clearly the trend in turntables this year. Sanyo's TP-1030 deck uses separate motors for platter and arm drive. For a full review, see August ETI.

Technics, who introduced the first domestic direct-drive turntable, have probably done more for direct-drive than any other manufacturer. The SL-5200 was one of a range of turntables they released for the Show.

The superb Nakamichi 582 cassette deck, designed for the metal tape cassette market, attracted a lot of attention at the Convoy International Stand.

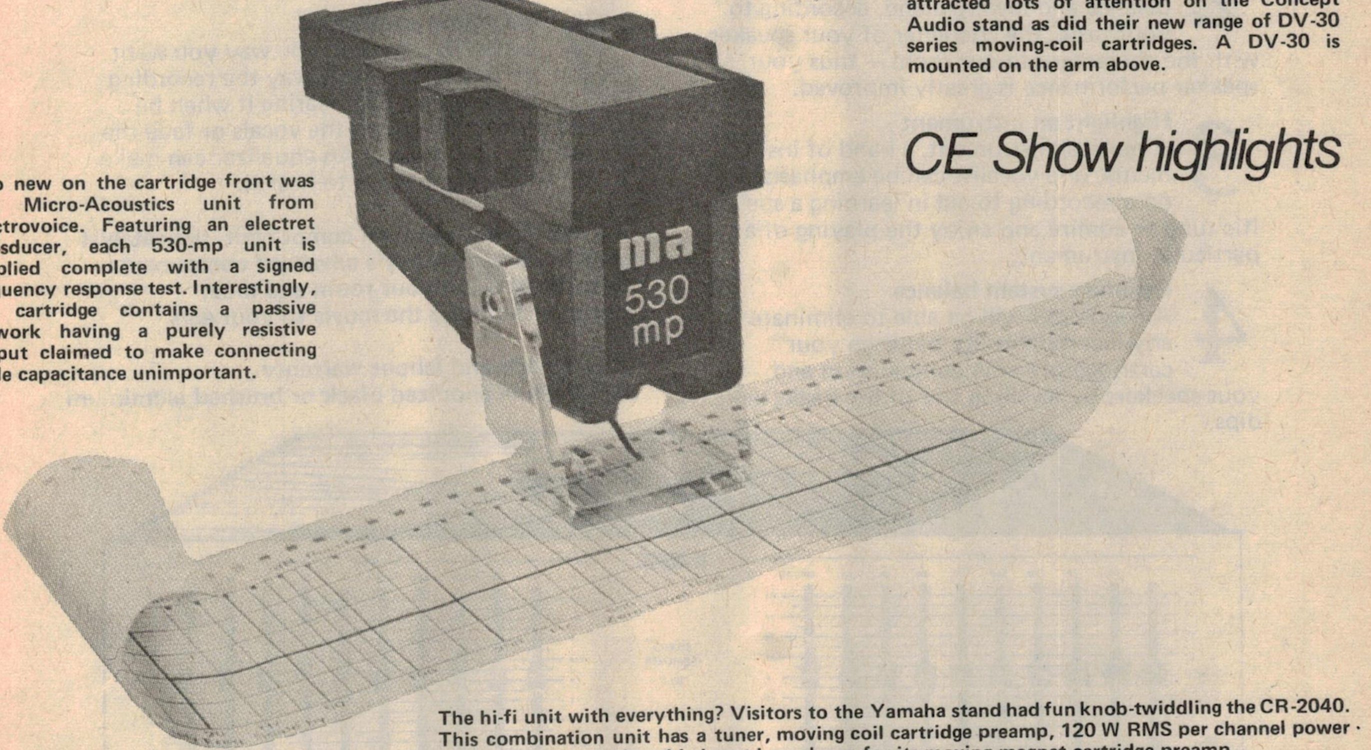
▶



Tape enthusiasts had much to drool over this year. Toshiba showed off their recently released Aurex PC-X6AD cassette deck featuring ADRES noise reduction. (This deck was reviewed in our June issue).

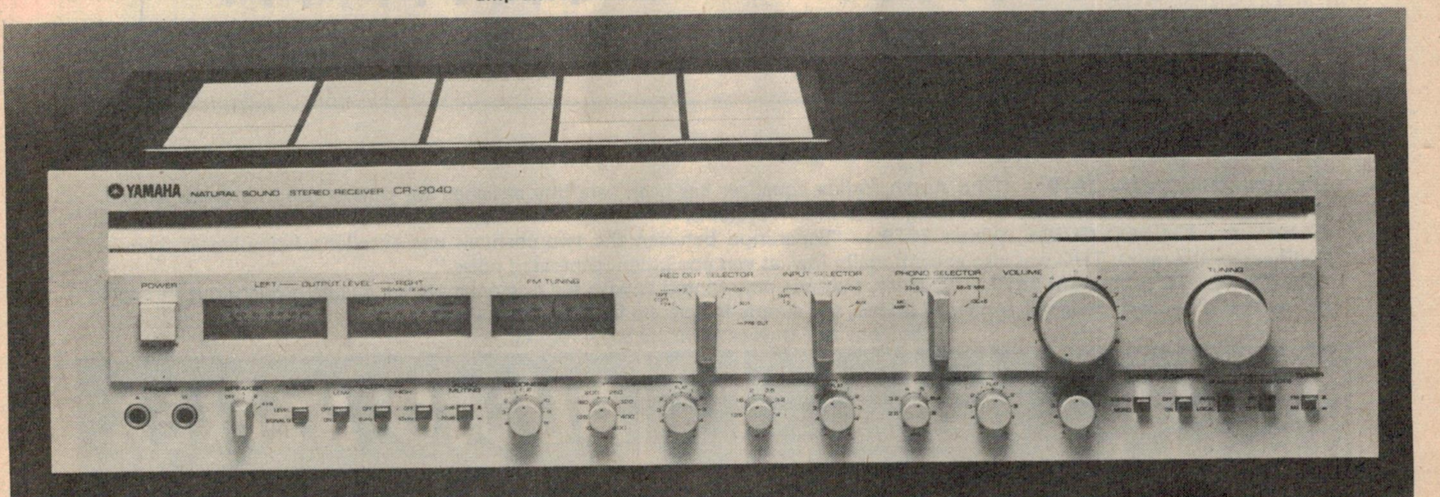
Dynavector's well-known DV-505 tone arm attracted lots of attention on the Concept Audio stand as did their new range of DV-30 series moving-coil cartridges. A DV-30 is mounted on the arm above.

CE Show highlights



Also new on the cartridge front was this Micro-Acoustics unit from Electrovoice. Featuring an electret transducer, each 530-mp unit is supplied complete with a signed frequency response test. Interestingly, the cartridge contains a passive network having a purely resistive output claimed to make connecting cable capacitance unimportant.

The hi-fi unit with everything? Visitors to the Yamaha stand had fun knob-twiddling the CR-2040. This combination unit has a tuner, moving coil cartridge preamp, 120 W RMS per channel power amp and features selectable input impedance for its moving magnet cartridge preamp.



CE Show highlights

Speakers

ALTHOUGH loudspeakers dominated the show this year, it was hard to tell how they sounded, the noise level inside the pavilions was appalling!

To a certain extent this is unavoidable at such shows. However, a couple of stands contributed more than their fair share to the overall level (mentioning no names — Ed.). Compliments to those with enough foresight to build decent display rooms (soundproofed ones!) in which their wares could at least be heard above the din.

Many manufacturers are getting away from the traditional rectangular cabinet shape. Notable examples included the B & W 801 speakers (distributed by Convoy) with its heavily chamfered edges and pyramidal top to minimise diffraction from the cabinet. The midrange and treble drivers of the 801 have been placed on top of the bass unit, to ensure good spherical dispersion. The RTR PS/1 and DAC/1 (from Acoustic Monitor) also featured separate enclosure for mid and high-frequency drivers for the same reason. They are distributed in this country by Acoustic Monitor.

Audio Engineers displayed their range of KEF speakers, including the 105. It is interesting to note that KEF is now designing constant-phase units — note the angled front panel in the photo at right.

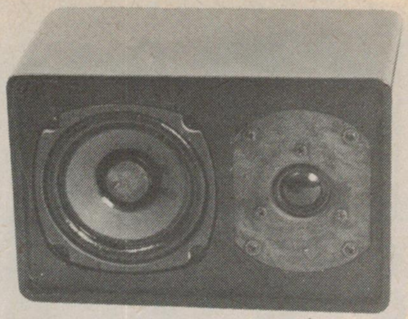
Concept Audio showed speakers from Jennings Research (new here) and Mirsch, including the Jennings Contrara Pedestal and Contrara Elan. This is a four-driver, three-way system — again, linear phase is a design feature.

Audio Reflex have entered another contender for the smallest speaker competition. Their AR-1 'Mighty Midget' features automatic overload protection, a 50 W power handling capacity and measures only 150 x 230 x 125 mm.

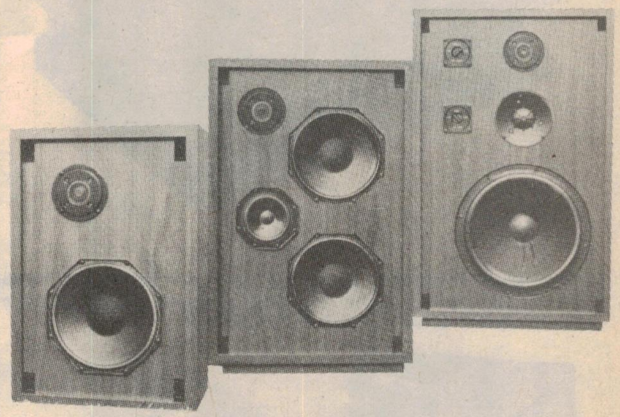
It's nice to see an Australian-designed, Australian-built product at such a large, prestigious show, and the Peterson range shows that we can do it just as well as the competition. Their Model 15 Reference speaker, a three-piece system with a separate sub-woofer enclosure, was interesting. We hope to have something more on these speakers in a future issue.

Electrovoice's 'Interface: D' utilises an interesting method of extending the bass range of the speaker — they introduce equalisation in the preamp chain, which is a trick pioneered by Bose with their 901.

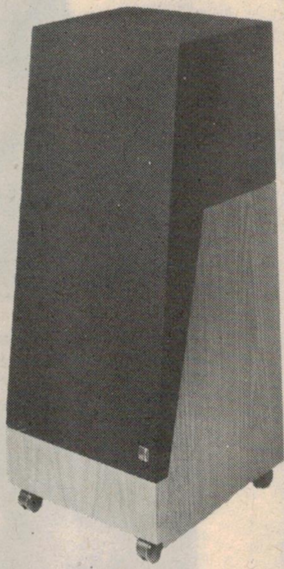
Once again, Philips showed their range of motional feedback speakers. This is where the most advanced concepts are employed in speaker technology. Power amps are included in the speaker enclosure, and the feedback system gives the range one of the best bass response/size ratios on the market.



The trend towards small, high performance speakers was much in evidence this year. These AR-1s from Audio Reflex (shown here out of proportion) stood out amongst the minis — they weigh only 2 kg and will handle 50 W RMS!



Jorlen Audio Industries had a stand featuring speakers — and nothing but speakers! For the do-it-yourself enthusiast they showed off their Sirius range of kits (above) featuring their locally-made cabinets and Philips drivers.



Audio Engineers showed a range of the latest KEF releases including everything from a tiny 'mini' to their model 105 which boasts excellent phase linearity and a smooth, extended frequency response. They also had a good display of headphones — rare at this year's show. They distribute the Koss range, an example being the Technician/VFR set at right.

CE Show highlights

Fluorescent level meters appeared everywhere this year. Typical of this trend in metering was Pioneer's SA-9800 amp.

Amplifiers

The general trend in amplifier technology reflects increasing awareness that the dynamic response of an amplifier is often more important than the static response.

Conventional distortion measurements are limited in that they use only a single frequency and level, whereas transient intermodulation distortion (TIM or TID) measurements do not. The recent market requirement for low-TIM amps has brought design and specification problems to many manufacturers. Universal standards on TIM measurements still do not exist. Amplifier speed — also a dynamic effect — is becoming a more important factor as people realise its effects.

Manufacturers are spending more and more time trying to reduce, measure and even identify the various forms of dynamic distortion — TIM, slew-induced distortion (SID), etc. This is not due to pressure from the consumer — but rather, the manufacturers **themselves** *are placing more and more emphasis on these factors.*

This was brought home by new amplifier ranges seen at this year's show.

Sansui now make a range of amplifiers designed around low dynamic distortion. These include the CA-F1 preamp and BA-F1 power amp. The power amp features a circuit technique called Diamond Differential DC — or DD/DC for short. This is claimed to decrease 'envelope distortion'. The DD/DC is a form of symmetrical output stage, giving greater control to the output devices. Sansui have defined envelope distortion as a kind of amplitude modulated TIM. Heavy low-frequency transient inputs cause voltage fluctuations at low voltage points in the circuit. This brings about a shift in circuit operation which causes distortion. By keeping the entire circuit differential, the supply rejection is also improved.

Built-in moving coil cartridge preamps seem to be becoming more popular, with most of the major new releases carrying them — Sanyo's 'Plus C55 preamp', the Pioneer SA-9800, Sansui's AUX-1 and Teac's BX-500, to name but a few.

Fluorescent level meters are becoming more and more common in both tape decks and amplifiers — the fact that they can show peak levels quickly and accurately is a decided advantage over conventional meter movements.

One development which flat dwellers will find particularly pleasing is the arrival of miniature hi-fi components — miniature, that is, in size only — not in performance. Unfortunately, there is no way to reduce the size of a turntable!

Falling somewhere between straight tone controls and a full-scale graphic equalizer, the tone controls featured on this Akai amp, their AM-2950, provide boost and cut at five frequencies across the audio range. This may herald a future trend.

Amongst Kenwoods' vast array of gear were a number of interesting high-speed dc integrated amps. This one, the KA-701, featured dual power supplies and variable bass and treble turnover.

Perhaps as a spin-off from the car sound market, there has been an upsurge of interest in ultra-small hi-fi gear. For those who don't have the room for gi-normous tuners, amps and speakers, Aiwa may have the answer with their mini-separates. Standard width of the units is a mere 210 mm !

▶

Miscellaneous

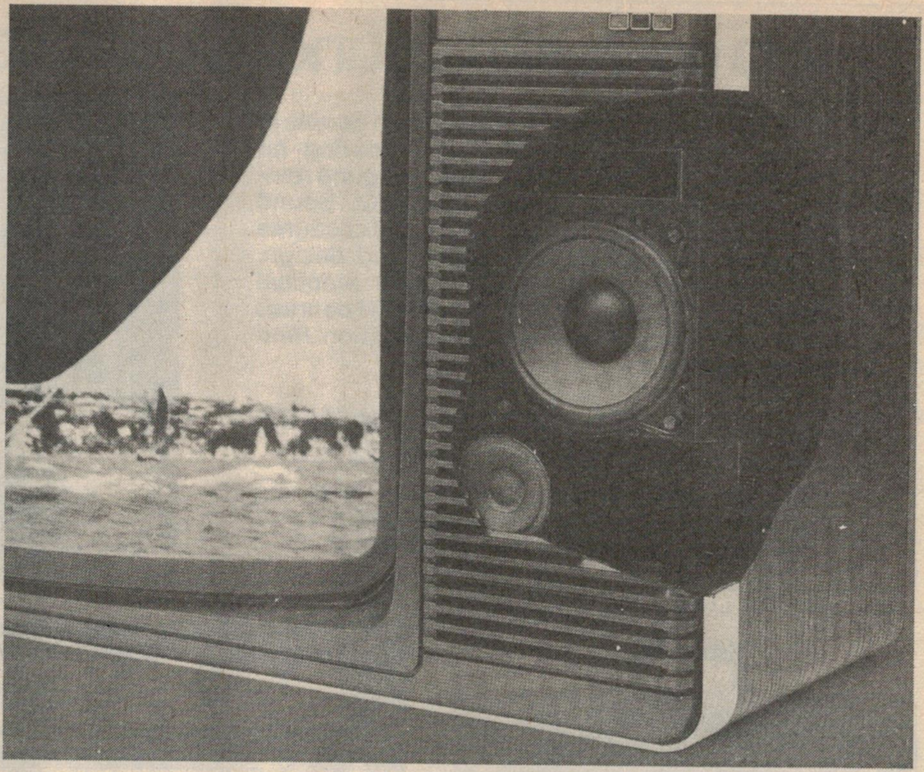
This year's Show produced a number of interesting new products — one beauty was Permostat, a liquid record care product which, when rubbed into the grooves of a record, is claimed to increase record life by reducing static charge so that dust particles are not attracted to the surface (dust particles, of course being a cause of wear when the record is played).

Electrovoice have taken over the distribution of dbx units from Superscope and were exhibiting the well known 3BX unit as well as two others — the 1BX and 2BX — which will form a more comprehensive range of stand-alone noise reduction units.

Car stereo systems seem to be heading towards 'do-everything' units with Voxson, Sanyo, Pioneer, Philips and others showing very sophisticated models — some with digital tuning and automatic station seeking facilities.

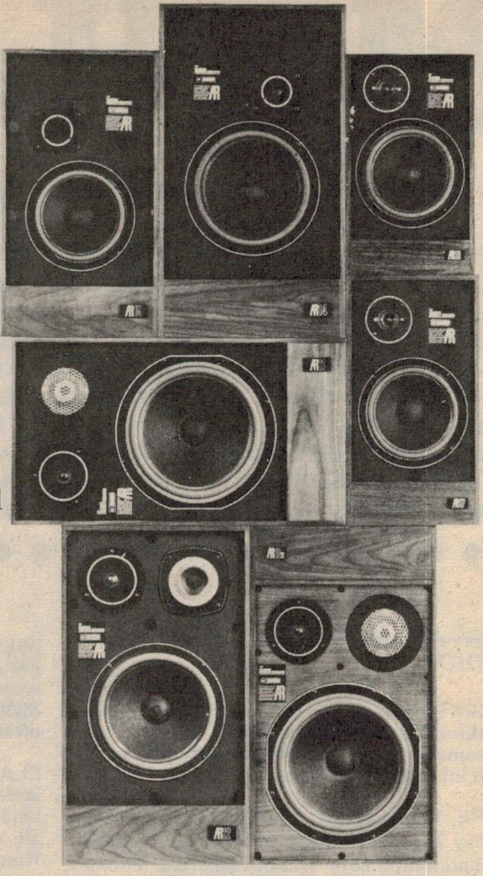
Electronic games are booming with Hanimex, Futuretronics and others showing a wide range from TV games to chess and even bridge-playing machines.

Video recorders were very much in evidence with Pioneer being the first to show a laser-based disc system.



While stereo TV sound is not yet a reality (except for simulcasts), Philips have realised that the fidelity of TV sound is just as important as the fidelity of the picture. Their 'hi-fi sound' receiver, released just before the show, features a two-way speaker system plus bass and treble controls. We wonder who'll be next ?

HOW MUCH MUST YOU PAY FOR A PAIR OF "DYNAMITE" SPEAKERS?



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SPEAKER system for sale. 50 WRMS 3-way. Features Philips 1 in glass domes, 12 in rubber surround woofers. Pineboard boxes built from kit. $200. J Ganter 44.5033.

RARE, complete set "Hi-Fi Review" Oct 74 to May 79. (No.1 edition to the last published) mint condition $60. Will not separate. Phone Ed (02) 620.1203, PO Box 203, Maroubra, NSW.

AUDITEC/Murray Amplifier for sale, 100 watts per channel, low transient intermodulation distortion $450 (contact Cliff Law), Brisbane (07) 38.3017.

FOR sale two Philips 8 inch woofers 1" tweeters crossovers for ETI 400 speaker system $70. ETI 439 pcbs $16 (pair). John Kingston phone (03) 434.3996 (AH).

MELBOURNE Hifi and Tape Friends — the Recording Society of Australia meets monthly for demonstrations, lectures and live-recordings. You are invited to come along. For syllabus and information write or phone Don Patrick, 36 Argyle St, MacLeod 3085, phone AH (03) 459.1717.

KEF Cadenza speakers, two years old, good condition. $280. Phone Darryl (AH) on (07) 371.5476.

FOR sale: Phase Linear 4000 Autocorrelator Preamplifier & Phase Linear 700B Power Amplifier as new, under warranty. Walnut cabinets & service manuals included - $1600. R J Hill, 54 Sixth Ave, St Peters, SA 5069. (08) 225.6142 (Bus).

FOR sale: Quad 405 current dumping power amplifier, 100 WRMS per ch into 8 ohms. As new $450. Pioneer TX-7500 FM/AM tuner, brand new $120. DBX 119 dynamic range enhancer, as new $150. R Hill, 54 Sixth Ave, St Peters, SA 5069 (08) 225.6142 (bus).

FOR sale: Sanyo DCX 8000K 50 watts RMS per channel receiver amp. $199. Very good review in Hi-Fi Review mag. 1 yr old, used very little, excellent condition. Ring Bob Taylor (02) 411.5119 (home) or (02) 33.4282 (work).

SELL: Hi-fi system. Comprising 50 WRMS per channel amplifier, speakers, turntable and cassette deck. All in excellent condition. $900 ONO. Phone Martin (049) 33.5944 after 6 p.m.

PLAYMASTER-75L 80W speakers, AM FM stereo clock tuner, 40/40 amplifier & graphic equaliser, all expertly constructed, must sell, all offers considered & will sell separately. Ring Leon (062) 54.2662 AH (ACT).

WANTED: Circuit diagram or other information for Star SA-855 stereo valve amplifier. Will pay. G Brooker (049) 63.4469, PO Box 255, Newcastle, 2300.

PRO 9 transmission line monitor loudspeakers using B139, K040 MR, Son Audax tweeter $1200. R Salter, 33 Belvedaire Way, Lynwood, WA 6155 350.7254

ELECTRONIC organ. 3/4 constructed. Solid wood body. 2 keyboards, pedals, 40 WRMS amplifier tone generators & dividers. Working - $375. Phone 622.4388 (BH) (047) 39.1348 AH.

COMMUNICATIONS

NOVICE study course by Hornsby & Districts ARC, Mondays 7 p.m. beginning 6 August, Hornsby Evening College $20 Theory Tuition, $5 Morse, phone (02) 868.2585.

AUSTRALIAN Radio DX Club, for shortwave and mediumwave DXers. Monthly magazine published. Write for details to PO Box 67, Highett, Vic 3190 or PO Box 79, Narrabeen, NSW 2101 with 30 cent stamp.

FOR sale: Realistic DX 160 communications receiver as new. 150 kHz to 30 MHz coverage. $110 ONO. M Kimber, 1 Lillis Rd, Gympie Qld 4570. Phone (071) 82.1055.

SELL: Communications receiver Trio 9R59DS — spotless condition $135. P Theodore, 26 Waratah St, Canterbury, NSW 2193.

TELETYPE ASR 33 as new cond with stand paper tape reader and punch RS 232 interface books and accessories $500 OBO. Norm (03) 531.7724.

TELETYPE Model 19 for RTTY $50. Teletype tape distributor $30. Phone Sydney (BH) 33.4282 — Roger Harrison.

FOR sale: 5 band realistic solid state communications receiver $160. Mr J Krambeck, 46 Kareela Rd, Bundanoon, NSW 2578, phone (048) 83.6232.

FOR sale Barlow Wadley XCR-30 Mark II all band receiver, as new $200. 5/24 Exelsior Rd, Cronulla, NSW 2230. (02) 523.6818.

SHORTWAVE listeners: Southern Cross DX Club, 87 Cashel St, Pasadena, SA 5042 produces "English Shortwave Stations Audible in Australia" for members. Send 20 cent stamp.

YAESU FT-DX-400 trnscvr in good condition 10-80 Mtrs with desk mike and ext speaker. $450. Costello, 3 Chandor Crt, Nth Clayton 3168. Phone (03) 560.8430.

SANYO TA4100 transceiver for sale digital readout 18 AM channels plus 27 MHz ant complete. Must sell $100. Bill Paulin, 3 Clovelly St, Watsons Bay. Phone 337.6003.

SELL: Electrophone CB-530 Citizens Band radio EC original packing. Cost $220 will sell for $150 ONO. Phone Dave after 4 p.m. (059) 85.3152, 30 Dunham St, Rye, Vic 3941.

SELL: Dick Smith Hornet SSB CB, Swamper II ½ wave aerial, SWR meter, cords, etc. The lot $200. Will separate. Phone Sydney 451.3737 ask for Andrew.

URGENT sale ISE AM-SSB power supply. Dick Smith TVI filter. Any offer considered phone Adelaide 295.1270.

FT200 transceiver with 240V power supply and FT200 club notes $350. Also Sanyo car radio cassette player $85. Chapman, 70 Cliff Road, Epping, NSW. 86.4785.

RCB-55 plus Densei DM307 power mike plus two magnetic mount aerials and one black knight. Contact R Elliott, 26 The Esplanade, Sylvania 2224. $45. Phone 522.8142.

SEII DR48 9 months old, excellent condition $400 ONO. Ring (08) 42.5092 ask for A Wyatt and Allen, St Peters College, St Peters SA 5069.

COMMENTARY

— from Richard Timmins

One cannot expect an exposition called a Consumer Electronics Show to consist entirely of audio equipment but, on the other hand, audiophiles can hope for improved quality of sound at demonstrations.

There's no doubt that this year's CES, the second at the RAS Showground in Sydney, eclipsed all its predecessors in terms of visual interest. Major exhibitors again went to town on their stands, displaying a vast range of products in dazzling settings.

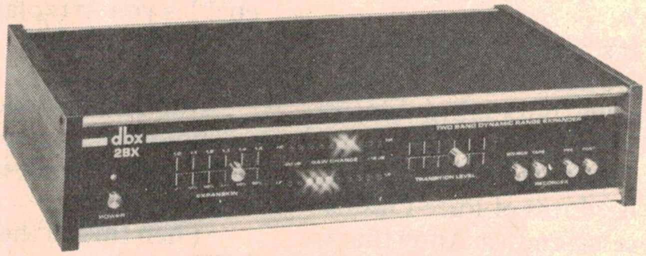
Unfortunately, this visual impact was not matched by the sounds heard, and while this state of affairs would be unlikely to deter the serious enthusiast from following up those interesting individual items of equipment by a later dealer demonstration, one can't help feeling that less committed visitors to the show would be put off. Although a hotel room is no substitute for listening to one's own living room, it does at least give a better impression than can be obtained at an 'open' show.

Apart from this, the open format does provide more relaxing surroundings for visitors, so the best solution as seen by this writer would be improved stand demonstrate without interfering so much with others.

Perhaps the biggest disappointments at this year's CES were the non-appearance of the AR-90 speaker — a smaller, less expensive version of the controversial AR9 — and a general lack of real innovation.

The show did, however, succeed in alerting visitors to the vast array of consumer electronics equipment now available, particularly in the videotape field. On that score it is hoped that a single international recording medium standard for domestic equipment might soon emerge, especially as prices are falling dramatically. Adoption of one standard now would avoid the kind of problems that prevailed when each manufacturer used its own equalisation characteristic for disc records — and the possible havoc arising from the existence of several videotape formats would be far greater. Matters are difficult enough in the audio cassette field, where despite the rigid enforcement of standards and specifications, problems have arisen from the enormous variety of magnetic properties of tape. Continued use of different types of video cassette, running at different tape speeds, is courting disaster.

Instead, manufacturers seem intent only on marketing their pet systems, and while it was clear at the CES that some work better than others, it was also clear that no manufacturers were prepared to concede this. It remains to be seen how this problem will, as it must, eventually be overcome. Meantime, videotape manufacturers are simply restricting their market while the cautious buyer procrastinates until such time as the future of videotape becomes more secure. ●

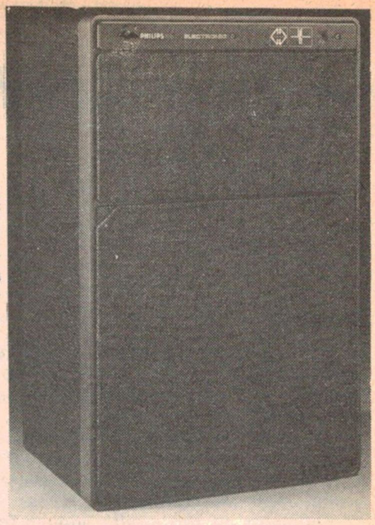


Prominent among the few noise reduction units on show this year were the dbx units, now marketed here by Electrovoice. Above is their 2BX unit, a dual band unit intended for record, tape and broadcast source applications.

For the first time at the CES, Concept Audio showed their Permostat anti-static treatment for records — with some very convincing demonstration material.

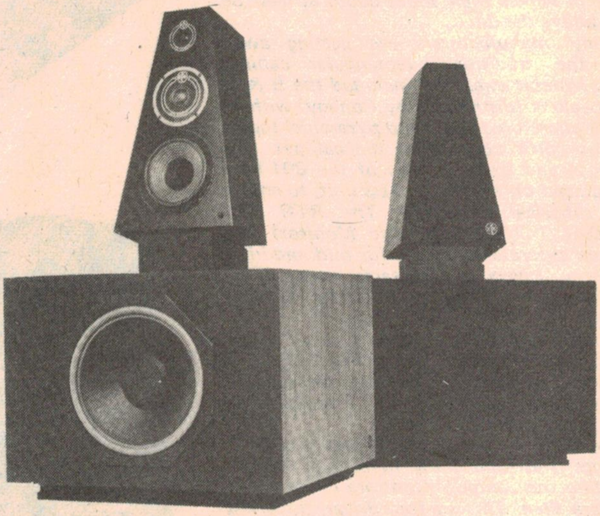
Car sound has progressed rapidly in the last year with much more sophisticated equipment appearing. Typical was Sanyo's FT-D10 stereo cassette deck with Dolby and mike mixing features.

LEFT: the Interface: D speaker, from Electrovoice, makes use of an equaliser in the preamp chain to extend the bass range.



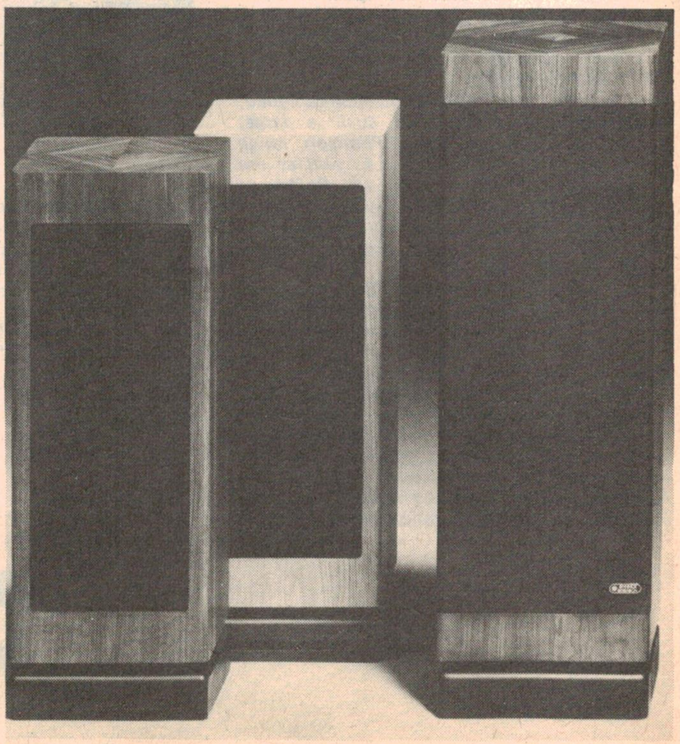
RIGHT: Philips motional feedback speaker systems gained a lot of attention again. The Philips stand featured a centrally-located soundproof demo room and a surrounding labyrinth featuring their other products. They won the exhibitors award.

The Acoustic Monitor Co. sensibly provided a soundproof (almost) room on their stand and gave impressive demonstrations of their Phase Linear amps and RTR speaker systems. The PS/1 and DAC/1 system (below right) impressed many listeners with an extended bass response — claimed to go down to 16 Hz.



Wedderspoon's stand featured walls made from speaker cartons! Flagship for the show was the AR9 (below) featuring an 'acoustic blanket' around the HF drivers to reduce diffraction.

These Jennings Research speakers (below), made in Los Angeles and known for their excellent cabinet-work and brilliant sound, were being shown for the first time in this country by Concept Audio.



After you experience our equalizer at work, unequalized sound just won't seem like music anymore!

1 Bad rooms become good rooms
The listening room is the final link in the audio chain. It determines, as much as any component, the sound that will reach your ears. Most homes are designed for comfort, not for acoustics. An equalizer can let you have it both ways by transforming a comfortable living room into an excellent listening room.

2 Good speakers become great speakers
An equalizer can improve speaker balance and ideally blend, according to your taste, the character of your speaker with the character of your room — thus your speaker performance is greatly improved.

3 Highlight an instrument
A musical instrument, a band of instruments, or a vocalist can be emphasised on a recording to aid in learning a speific tune or admire and enjoy the playing of a particular instrument.

4 Optimise system balance
An equalizer will be able to eliminate any incompatibility between your cartridge/pre amp combination and your speakers by levelling any of the-peaks or dips.

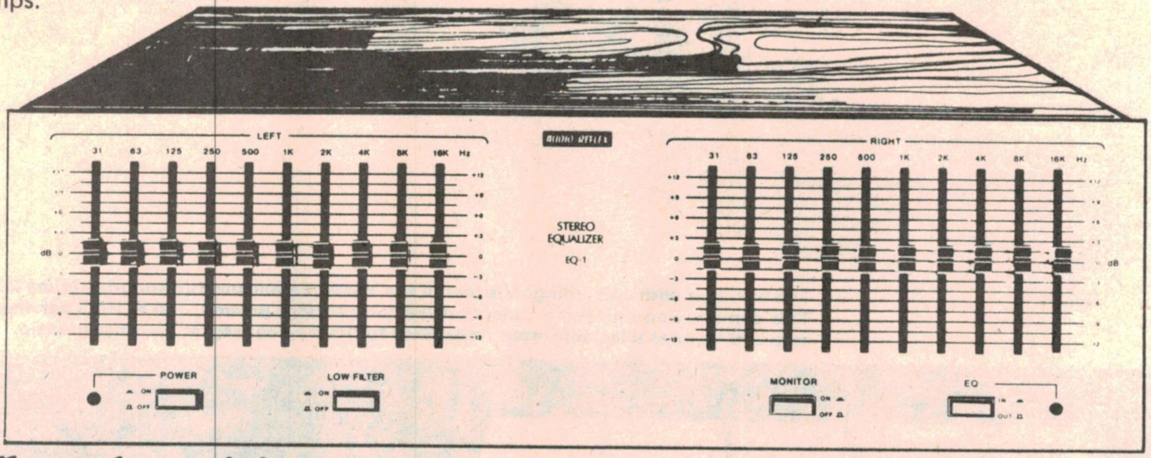
5 Improve source material (records etc)
An equalizer can upgrade the sound of your source material by reducing record rumble and surface noise, hushing tape hiss and stiffling radio static.

6 Improve your recording
Get professional quality effects by shaping the sound of the program material to achieve the results that you want on tape.

7 Make you own music
Listen to the music the way you want to hear it — not the way the recording engineer felt like hearing it when he mixed it down. Bring up the vocals or fade the guitar. It's your choice. An equalizer can make music anyway you want to hear it.

An equalizer is the final component, the catalyst which will tune today's advanced components to each other, to your room and most importantly, tune the music to your ears.

3 year parts and labour warranty.
Available in anodized black or brushed aluminium



What the critics say......

HI-FI & MUSIC, May 1979 — "The Audio Reflex equalizer has been carefully designed for general use in systems owned by audiophiles who require that 'something extra' in hi-fi systems."
CANADIAN STEREO GUIDE, Winter 1979 — "Separation between the two channels was excellent, being better than — 64dB across the range. THD was also exceptionally low, as was equipment generated noise."
THE FM GUIDE (Canadian) 1979 — "Quality, that was only hinted at with the original material, can be brought out through proper use of this well-designed, modestly priced, and simple-to-operate frequency equalizer."
(Copies of full reviews available upon request.)

AUDIO REFLEX

You'll hear more from us......

Australian Distributor: **Audio Reflex (AUSTRALIA) PTY. LTD.**

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‘A coming of age’

Australia’s fourth Consumer Electronics Show

Sydney Showground, July 18-22

This year’s show filled two huge pavilions, was supported by more exhibitors than ever before — and attracted huge numbers of interested people. We thought it was great — apart from a minor grumble about the sound. ETI’s Managing Editor, Collyn Rivers reports . . . .

‘WHERE there’s music there can be no evil’ — said Cervantes in Don Quixote. He’d have undergone a dramatic change of mind if he’d spent five days on our stand at the ’79 CES!

Overall it was a **good** exhibition. Particularly as the promoters and exhibitors had been caught by coinciding mail, Telecom, and petrol strikes.

BUT wall to wall Donna Summer at 120 dB is not the very best way to convince the public to buy hi-fi. In the words of many a visitor ‘it all sounds the same’.

Disco music is not **intended** for listening to — it’s a sort of dbxed Muzac and, with the greatest respect to its practioneers/perpetrators, it sounds much the same through a pair of Quads as through a ten metre stack of Cervin Vegas with stuffed tweeters.

Either way it doesn’t have all that much to do with hi-fi.

So, how about it next year fella’s — we know Bartok’s not for everyone but out there’s heaps of good rock and roll, fine jazz, and lots more besides.

Another criticism we encountered was that ‘it’s not really a consumer electronics show’. But on this point we sympathise with the organisers and sponsors whose task it was to decide what was and what wasn’t ‘consumer electronics’.

Does something cease to be in this category when it becomes taken for granted — as say a microprocessor controlled washing machine? — Or its equivalent, master-minding the varied and intricate sequences of a sewing machine?

Or is a ‘consumer electronic’ something in which the technology is outwardly obvious — perhaps even partially bought for that reason — a sort of solid-state Ferrari?

It’s easy to criticise, especially when one’s not faced with the problem — but it **is** a problem and it **will** have to be resolved.

What was easy to see was the continuing value for money offered to consumers.

As Les Black, retiring President of the Hi-Fi Association pointed out in his opening address, “not only have prices often reduced in real terms, but the products are significantly better each year because of the advances in technology . . . you can buy cassette decks with microprocessors, calculators under $10, video cassette machines under $800, colour TV’s under $300.”

And all this despite 35% import duty on most!

There were the usual Show undercurrents. Had we heard that so and so’s metal tape deck couldn’t erase a pussy cat if you put it down a blender. Or that the new Quad speaker works by steam — or that Dick S . . . s gone down the gurgle at last.

There were also the memorables. Derek and Jackie Pugh’s valiant 12 hour stints demonstrating their excellent Permostat record cleaner: the new Wynn turntable: Pioneer’s VideoDisc: the truly Junoesque lady from Penthouse: a major distributor demo’ing the ubiquitous Donna for a full half day without noticing he’d switched the player to 45 rpm.

Then there were Superscope’s Marantz balloons, several of which were observed hovering low over Bondi Junction on the Tuesday morning following the show. They were good balloons, three were ‘borrowed’ by our staff to support the far end of a long wire antenna!

And then there was a stand next but one to the German booze people (what **they** had to do with consumer electronics we’ll never know!) who were doing computer horoscopes at $2.00 a go. Quite freaked us out — we didn’t previously know non-Leos even **had** star signs.

It was a *good* Show. See you next year.

COMPUTING

TRS-80 Level One, ex cond, with manual, assorted software and literature. 4k RAM. $690. Jack Stam, 9 Kanooka Grove, Doveton 3177. Phone (03) 791.3782.

KT9500, 2650 M/B (8k RAM), lots software $350, 10A Reg P/S $70, EME-2 graphics terminal with cassette interface (PLL) in case $400. Terry (02) 682.4649.

FRIDEN Flexowriter for sale. Good cond, with circuit diagram, paper tape, punch and reader, and ALU – $300. Phone David Powers (02) 560.7603 AH.

2650, 2608 (PIPBUG) – $15 ea, 2102AL-4 6 for $5, MM5740AAF – $12, MM5303 – $3. 54 key keyboard (ASCII) – $40 ONO. Special deal for lot. Ring R Munn (08) 293.4925.

KT9500 (2650) computer. 4k RAM EPROMS. EME-1 VDU, cassette interface, Hall ASCII keyboard. Professional cabinets. Working. Software, Basic, Astrotrek $300. Rutherford, Jiri Place, Engadine (02) 520.0926.

TRS-80 L2 software (on cassette) full documentation, 39 prog's incl games, teaching aids, mathematics, etc. $9 + $1 p&p. J Anderson, 225 Ocean Beach Rd, Sorrento 3943.

POLLY-88 Micro S-100 system, 16k, keyboard, VDU, cassette, BASIC, assembler. Cost $1600, offers $800. P Hooker, 5 Third Ave, Mt Lawley 6050 (09) 271.9669.

ADELAIDE: Sell Olivetti microcomputer, with programmable: electric typewriter, calculator with numeric printer & magnetic card reader, 7-track cartridge recorder. $1500 ONO. (054) 337.7024.

OPTICAL PTR you pull - it reads $50; full ASCII keyboard single +5V supply : $75; both docum included. R Pfotenhauer, PO Box 81, Lyneham 2602.

4 MHz Z80 A & T $150, VDU upper-lower case graphics A & T $180, 2708/16 EPROM A & T $100 all Ithaca Audio. R Pfotenhauer, PO Box 81, Lyneham 2602.

TI speak and spell interface for 6502 systems $50, 16 and 14 pin IC sockets 1 cent/pin. R Pfotenhauer, PO Box 81, Lyneham 2602.

TRS-80 owners – RS232 interface plus software program to use LLIST and LPRINT commands – no expansion interface necessary – $65. Circuit diagram and software listing only $15. For more info write PO Box 122, Bondi Beach, NSW 2026. Programs available also on a swap basis.

EXIDY sorcerer 16k with cassette recorder, video monitor, software, manuals, etc. Complete minicomputer system cost $1500, will sell $1000. Hardly used. Paul (02) BH 231.9437.

'BASIC' language computer programs. Listings and instructions available for many games and other programs. For details please send SSAE to B Kakoschke, C/- 28 Rellum Rd, Greenacres SA 5086.

TRS-80 programs – for sale or on swap basis – write to R Gareb, 17/37 O'Donnell St, Bondi, 2026 or phone (02) 30.8261.

FOR sale: Intel 8085A $18, 8155 $15, 8279-5 $15, never used. Bob (049) 43.4488.

SELL: Signetics KT9500 micro board. 2k RAM, 1k EPROM socket. Decoded for further expansion. Power supply included $135. Laird, 8 Kilkenny Rd, Penrith, NSW 2750, phone (047) 21.5333.

EA Miniscamp – any offers? Also EA VDU + modulator, no (LF) – no time to rectify. Both working well. Phone Mike (SA) 31.4635.

SELL: Motorola D1 evaluation kit. Complete, but not tested, with new ICs including CPU 2 PIAs 1 ACIA MIKbug ROM; $95. 3 Gwenda Ave, Blackburn 3130. (03) 878.0469.

MEMORY 8k new Econoram II Godbout unkit. S100 2102-L1 450 ns switch select 4k boundries $198, H T Young, 1 Trafalgar Ct, Lesmurdie, WA 6076, phone 291.8381.

MEK6800 D2 assembled ½k byte 5V2A power $250. Programmable TV game 3 cartridges power supply $100. C Wyatt, C/- 29 Queen St, Kangaroo Flat, Vic 3555. Phone (054) 47.7366.

MICRO-ICs 15 off 8251 USART $5 each; 48 off 2111A (450) 256 x 4 RAM $1 each; 10 off 8205 address decoder $1 each; Mike Fletcher, 57 Tryon Rd, Lindfield 2070. Phone (02) 46.3312.

SELL: DG640 VDU complete $110. Almost complete ETI 630 VDU kit $80. Attack delay unit $30. G Cottew, 32 Hanover St, Fitzroy 3065. Phone BH (03) 669.4329.

MISCELLANEOUS

COLOUR Pal Monitor studio quality Tektronix 671, 17 inch 2-chan includes VHF tuner manual & schematics. D Strong, 9 Tudor Pl, St Ives, NSW (02) 449.5885. $375.

SELL Multitester BX-505 year old $30. Ring (08) 42.5092 ask for M S Perera Wyatt and Allen House, St Peters College, St Peters, SA 5069.

SELL power supply Dickie's M.9546 2 month old $35. Ring (08) 42.5092 ask for Ross Pearce, Wyatt and Allen House, St Peters College, St Peters, Adelaide SA 5069.

NOTICE: The MBA Astronomy Association of WA announces the start of Skylab Expedition to NASA Headquarters, USA in September. Call M Elyk (095) 21.1979.

URGENTLY required: Shibaden Video Heads (red painted) or equivalent, will exchange for video tapes or other arrangement. R Googe, 15 Woodgate St, Ipswich, Qld 4305. Phone (07) 281.8316 (AH).

WANTED new members to join BTRC Worldwide Tapespondance Club. Sound magazine printed Magazine Round Rounds. SAE to BTRC, PO Box 118, Wellington 2820.

STRIP Chart Recorder 3-pen 4½ inch dual speed with manual & schematics. D Strong, 9 Tudor Place, St Ives, NSW (02)449.5885 $245.00.

WANTED ETI Circuits No. 1, also ETI Top Projects No. 1, G Hoelzer, Box 145 Coober Pedy, SA 5723.

FOR sale 20 dozen RT+H magazines 1950-1970. Best offer. Phone Melb 568.3503.

HAVE you a tape recorder. Then why not join Boomerang Tape Recording Club, PO Box 118, Wellington, NSW 2820. Phone 738.

SELL: Trio CS-13030 oscilloscope & ETI 143 curve tracer. ETI 137 AF oscillator, 114 dual beam adaptor, 106 'scope calibrator in one unit. The lot $430. Ring Henry A (03) 850.8918.

ETI kits: 414 mixer; spring reverb working; 100 watt amp; sig tracer, plus new components, ICs, etc. You make offer. (02) 869.2970.

POWER supply professional heavy duty unit 6 individual isolated regulated outputs 5V/7.5 A, 5-6V/2.5A, 12V/2.5A, 24V/5A, 18-20V/2.5A, 18-20V/2.5A strappable for +/-. D Strong, 9 Tudor Pl, St Ives, NSW (02) 449.5885. $145.

FOR sale: Experimenter's Junk box. Contains assorted parts, mostly ex-radio ex-TV. $7, no including postage, write G Hausfeld, 434 Conadilly St, Gunnedah 2380.

ETI 541 Dual Auto Reverse train controller, fully electronic brake and inertia. Suits gauges - HO, TT, N and Z, mains operated. Professional finish front panel $60 (02) 630.2148.

SELL: BWD 539C Dual Trace 20 Megahertz CRO 2 x P32 probe kits. Save over $200 on new price. Hardly used $400. P Willis, 4/98 1st Ave, Sawtell (066) 53.2098.

TEST equipment: RC Bridge, Tube Tester, VTVM, 150k – 3.5 Meg sig gen, TV-FM sig gen, repairable 5" CRO. The lot $200. Tel (02) 913.2606.

BUY or BORROW - circuit diagram and/or operators manual for a Thom & Smith TS100 communications receiver. Write: B. Flyger, Box 180, Greymouth New Zealand.

QTY.	DIODES/ZENERS			
	1N914	100v	10mA	.05
	1N4005	600v	1A	.08
	1N4007	1000v	1A	.15
	1N4148	75v	10mA	.05
	1N4733	5.1v	1 W Zenner	.25
	1N4749	24v	1W	.25
	1N753A	6.2v	500 mW Zener	.25
	1N758A	10v	"	.25
	1N759A	12v	"	.25
	1N5243	13v	"	.25
	1N5244B	14v	"	.25
	1N5245B	15v	"	.25
	1N5349	12v	3W	.25

QTY.	SOCKETS/BRIDGES				
	8-pin	pcb	.16	ww	.35
	14-pin	pcb	.20	ww	.40
	16-pin	pcb	.25	ww	.45
	18-pin	pcb	.30	ww	.95
	20-pin	pcb	.35	ww	1.05
	22-pin	pcb	.40	ww	1.15
	24-pin	pcb	.45	ww	1.25
	28-pin	pcb	.50	ww	1.35
	40-pin	pcb	.55	ww	1.45
	Molex pins	.01	To-3 Sockets		.35
	2 Amp Bridge		100-prv		.95
	25 Amp Bridge		200-prv		1.50

QTY.	TRANSISTORS, LEDS, etc.		
	2N2222M	(2N2222 Plastic .10)	.15
	2N2222A		.19
	2N2907A	PNP	.19
	2N3906	PNP (Plastic)	.19
	2N3904	NPN (Plastic)	.19
	2N3054	NPN	.55
	2N3055	NPN 15A 60v	.60
	T1P125	PNP Darlington	1.95
	LED Green,	Red, Clear, Yellow	.19
	D.L.747	7 seg 5/8" High com-anode	1.95
	MAN72	7 seg com-anode (Red)	1.25
	MAN3610	7 seg com-anode (Orange)	1.25
	MAN82A	7 seg com-anode (Yellow)	1.25
	MAN74	7 seg com-cathode (Red)	1.50
	FND359	7 seg com-cathode (Red)	1.25

QTY.	9000 SERIES		QTY.		
	9301	.85		9322	.65
	9309	.50		9601	.30
				9602	.45

QTY.	MICRO's, RAMS, CPU's, E-PROMS	
	8T13	2.50
	8T23	2.50
	8T24	3.00
	8T97	1.75
	74S188	3.00
	1488	1.25
	1489	1.25
	1702A	4.50
	AM 9050	4.00
	ICM 7207	6.95
	ICM 7208	13.95
	MPS 6520	10.00
	MM 5314	4.00
	MM 5316	4.50
	MM 5387	3.50
	MM 5369	2.95
	TR 1602B	3.95
	UPD 414	4.95
	Z 80 A	22.50
	Z 80	17.50
	Z 80 P10	10.50
	2102	1.45
	2102L	1.75
	2107B-4	4.95
	2114	9.50
	2513	6.25
	2708	11.50
	2716 D.S.	34.00
	2716 (5v)	69.00
	2758 (5v)	26.95
	3242	10.50
	4116	11.50
	6800	13.95
	6850	7.95
	8080	7.50
	8085	22.50
	8212	2.75
	8214	4.95
	8216	3.50
	8224	4.25
	8228	6.00
	8251	7.50
	8253	18.50
	8255	8.50
	TMS 4044	9.95

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QTY.	– T T L –		QTY.			QTY.			QTY.		
	7400	.20		7492	.45		74H20	.25		74LS76	.70
	7401	.20		7493	.35		74H21	.25		74LS86	.95
	7402	.20		7494	.75		74H22	.40		74LS90	.85
	7403	.20		7495	.60		74H30	.30		74LS93	.85
	7404	.20		7496	.80		74H40	.35		74LS96	2.00
	7405	.35		74100	1.15		74H50	.30		74LS107	.90
	7406	.25		74107	.35		74H51	.30		74LS109	1.50
	7407	.55		74121	.35		74H52	.20		74LS123	1.95
	7408	.20		74122	.55		74H53	.25		74LS138	2.00
	7409	.25		74123	.55		74H55	.25		74LS151	.95
	7410	.20		74125	.45		74H72	.35		74LS153	1.15
	7411	.25		74126	.45		74H74	.35		74LS157	1.15
	7412	.25		74132	.75		74H101	.95		74LS160	1.15
	7413	.45		74141	.90		74H103	.55		74LS164	2.90
	7414	.75		74150	.85		74H106	1.15		74LS193	2.00
	7416	.25		74151	.95		74L00	.30		74LS195	1.15
	7417	.40		74153	.95		74L02	.30		74LS244	2.90
	7420	.25		74154	1.15		74L03	.35		74LS259	1.50
	7426	.25		74156	.70		74L04	.40		74LS298	1.50
	7427	.25		74157	.65		74L10	.30		74LS367	1.95
	7430	.20		74161/9316	.75		74L20	.45		74LS368	1.25
	7432	.30		74163	.85		74L30	.55		74LS373	2.50
	7437	.20		74164	.75		74L47	1.95		74S00	.45
	7438	.30		74165	1.10		74L51	.65		74S02	.45
	7440	.20		74166	1.75		74L55	.85		74S03	.35
	7441	1.15		74175	.90		74L72	.65		74S04	.35
	7442	.55		74176	.95		74L73	.70		74S05	.45
	7443	.45		74177	1.10		74L74	.75		74S08	.45
	7444	.45		74180	.95		74L75	1.05		74S10	.45
	7445	.75		74181	2.25		74L85	2.00		74S11	.45
	7446	.70		74182	.75		74L93	.75		74S20	.35
	7447	.70		74190	1.25		74L123	1.95		74S22	.55
	7448	.50		74191	1.25		74LS00	.40		74S40	.30
	7450	.25		74192	.75		74LS01	.40		74S50	.30
	7451	.25		74193	.85		74LS02	.45		74S51	.35
	7453	.20		74194	.95		74LS03	.45		74S64	.15
	7454	.25		74195	.95		74LS04	.45		74S74	.70
	7460	.40		74196	.95		74LS05	.45		74S112	.60
	7470	.45		74197	.95		74LS08	.45		74S114	.85
	7472	.40		74198	1.45		74LS09	.45		74S133	.85
	7473	.25		74221	1.50		74LS10	.45		74S140	.75
	7474	.30		74298	1.50		74LS11	.45		74S151	.95
	7475	.35		74367	1.35		74LS20	.45		74S153	.95
	7476	.40		75491	.65		74LS21	.45		74S157	.98
	7480	.75		75492	.65		74LS22	.45		74S158	.80
	7481	.85		74H00	.20		74LS32	.50		74S194	1.50
	7482	.95		74H01	.30		74LS37	.45		74S196	2.00
	7483	.95		74H04	.30		74LS38	.65		74S257 (8123)	2.50
	7485	.75		74H05	.25		74LS40	.70		8131	2.75
	7486	.55		74H08	.35		74LS42	.95			
	7489	1.05		74H10	.35		74LS51	.75			
	7490	.55		74H11	.25		74LS74	.95			
	7491	.70		74H15	.45		74LS75	1.20			

QTY.	C MOS		QTY.			QTY.			QTY.		
	4000	.15		4017	.75		4034	2.45		4069/74C04	.45
	4001	.20		4018	.75		4035	.75		4071	.25
	4002	.25		4019	.35		4037	1.80		4081	.30
	4004	3.95		4020	.85		4040	.75		4082	.30
	4006	.95		4021	.75		4041	.69		4507	.95
	4007	.25		4022	.75		4042	.65		4511	.95
	4008	.75		4023	.25		4043	.50		4512	1.50
	4009	.35		4024	.75		4044	.65		4515	2.95
	4010	.35		4025	.25		4046	1.25		4519	.85
	4011	.30		4026	1.95		4047	2.50		4522	1.10
	4012	.25		4027	.35		4048	1.25		4526	.95
	4013	.40		4028	.75		4049	.65		4528	1.10
	4014	.75		4029	1.15		4050	.45		4529	.95
	4015	.75		4030	.30		4052	.75		MC14409	14.50
	4016	.35		4033	1.50		4053	.95		MC14419	4.85
							4066	.75		74C151	2.50

QTY.	I²L, LINEARS, REGULATORS, ETC.		QTY.			QTY.		
	MCT2	.95		LM320K24	1.65		LM373	3.95
	8038	3.95		LM320T5	1.65		LM377	3.95
	LM201	.75		LM320T12	1.65		78L05	.75
	LM301	.45		LM320T15	1.65		78L12	.75
	LM308	.65		LM323K	5.95		78L15	.75
	LM309H	.85		LM324	1.25		78M05	.75
	LM309 (340K-5)	1.50		LM339	.75		LM380 (8-14 Pin)	1.19
	LM310	.85		7805 (340T5)	1.15		LM709 (8-14 Pin)	.45
	LM311 (8-14 Pin)	.75		LM340T12	.95		LM711	.45
	LM318	1.50		LM340T15	.95		LM723	.40
	LM320H6	.79		LM340T18	.95		LM725	2.50
	LM320H15	.79		LM340T24	.95		LM739	1.50
	LM320H24	.79		LM340K12	1.25		LM741 (8-14)	.45
	7905 (LM320K5)	1.65		LM340K15	1.25		LM747	1.10
	LM320K12	1.65		LM340K18	1.25		LM1307	1.75
	LM320K15	1.65		LM340K24	1.25		LM1458	.65
							LM3900	.95
							LM75451	.65
							NE555	.45
							NE556	.85
							NE565	1.15
							NE566	1.25
							NE567	.95
							TA7205	6.95
							76477	2.95
							95H90	9.95

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HOW'S YOUR BLOOD PRESSURE?

Take your own blood pressure quickly and accurately in your own home or office

Introducing the Unitrex Home Blood Pressure Monitoring Kits!

A SPHYGMOMANOMETER can help protect you and your family against one of the most dreaded human killers in the world — heart disease and other illnesses associated with abnormal blood. It is not surprising then that hundreds of thousands of people world-wide are buying their own personal blood pressure monitoring devices — NOT as replacements for regular medical checks. But simply as an extra precaution for peace of mind.

One of the best known home units is the Home Blood Pressure Monitoring Kit from Unitrex. A substantial quantity of these were imported by Australia's Caldor Corporation and sold extensively via chemists — they were also offered via mail order.

Caldor have a number of these units still available which they are offering to our readers for the **very low price of $29.95 — plus $2.50 post and packing.** The kit includes the professional blood pressure unit itself, a nurse's stethoscope, a complete instruction book and three month's supply of blood pressure recording forms.

Please note: This offer is made by the Caldor Corporation, 12 Terra Cotta Drive, Blackburn, Vic., 3130. This magazine is acting as a clearing house for orders only. Cheques should be made out to 'Caldor Offer' and sent together with order to 'Caldor Offer', Electronics Today Int., 15 Boundary Street, Rushcutters Bay, NSW, 2011. ETI will process orders and pass them on to Caldor who will then send out the units by certified mail. Please allow approximately four weeks for delivery.

Caldor Offer

Please send me:

. . . . Quantity — Unitrex blood pressure monitoring kit/s at $29.95 each $ . . . .

plus postage at $2.50 each $ . . . .

TOTAL $

Name . . . .

Address . . . .

. . . . Postcode . . .

Please make cheques/postal notes payable to 'Caldor Offer' and send C/- Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011.

KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have only listed the projects published in the last two years, with their dates of publication, so this page can also be used as an index, even though kits are not available for some of them (as far as we know). Any companies who wish to be included in this list should phone Jan Collins on 334282.

Printed circuit boards

Those suppliers listed against specific projects here are able to supply pc boards for those projects. Printed circuit boards for every project ever published in ETI are available through the following companies (to the best of oui knowledge):

RCS Radio	Radio Despatch Service
651 Forest Rd	869 George St
Bexley NSW	Sydney NSW 2000

Work on updating this list is currently in progress. Letters have been sent to suppliers and a full update will appear shortly.

Key to Companies

A: Applied Technology Pty Ltd, 1A Paterson Avenue, Waitara, NSW 2077.
B: Bill Edge Electronic Agencies, 115 Parramatta Road, Concord, (PO Box 1005, Burwood North 2134).
C: J.R. Components, PO Box 128, Eastwood NSW 2122.
D: Dick Smith Electronics P/L, PO Box 747, Crows Nest, NSW 2065.
E: All Electronic Components, 118 Lonsdale Street, Melbourne, Vic 3000.
J: Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000.
K: S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109.
L: Tasman Electronics, 12 Victoria Street, Coburg Vic 3058.
M: Mode Electronics, PO Box 365, Mascot, NSW 2020.
N: Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011.
O: Orbit Electronics, PO Box 7176, Auckland, New Zealand.
P: Pre-Pak Electronics, 718 Parramatta Road, Croydon, NSW 2132.
R: Rod Irving Electronics, Shop 499, High Street, Northcote, (P.O. Box 135), Vic 3070. Phone (03) 489-8131.
T: Townsville Electronic Centre, 281E Charters Towers Road, Rising Sun Arcade, Townsville Qld 4812.
V: Silicon Valley, 23 Chandos Street, St Leonards, NSW 2065.

Project Electronics

041 Continuity Tester . . . . T,D,B
042 Soil Moisture Indicator. . . . . T,D,B
043 Heads or Tails Circuit (Oct 76) . . T,D,E,A,B,L
044 Two Tone Door Bell (Oct 76). . T,D,E,O,A,B,L
045 500 Second Timer . . . . T,D,O,A,B
047 Morse Practice Set . . . . T,D,O,A,B
048 Buzz Board . . . . .T,D,A,B
061 Simple Amplifier (Oct 76). . . . . . T,D,O,A,B
062 Simple AM Tuner (Mar 77) . . . . D,E,B
063 Electronic Bongos. . . . . D,A,B
064 Simple Intercom (Nov 76). . . . . . . .T,O,A,B
065 Electronic Siren. . . . . .D,O,A
066 Temperature Alarm (Dec 76) . . . . T,D,E,A,B
067 Singing Moisture Meter. . . . . D,B
068 LED Dice Circuit (Oct 76). . . . . . T,D,E,A,B
070 Electronic Tie Breaker (Jan 77)
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DREGS

Doodles, Ramblings, Exclamations, Gee-whiz & Stuff like that

Any of our readers who do development work which is overseen by a marketing-oriented boss will no doubt cringe in sympathy with this story.

During the Second World War (remember the Second World War?), a high-ranking naval officer visited a research establishment and got chatting to one of the scientists. "I say", he said (this was in England, remember), "Why don't you scientist chappies come up with something that will remove all of the sea water in, say, a one mile square of sea. Any of these nasty German U-boats in the area would then be left high and dry to be mopped up by the Infantry."

The scientist calmly pointed out the enormous amount of energy this would require, and pointed to the Red Sea as the only example of the technique being used.

Undaunted, the officer said, quite stiffly, "Look here, don't bother me with details. After all, that's what we pay you chaps for." He then left, muttering something about Cambridge graduates not being what they used to be.

Anyone got a similar story? Write and tell us about it.

Saving energy

Doesn't it make your heart warm to hear that the leaders of the Western World really care about saving energy? They travelled (seven of them) all the way to Tokyo to rack their brains trying to reduce even further the energy needs of the West.

One enterprising New York Times reporter, however, had a suggestion which could help those musing leaders to come to terms with what saving energy is all about — that the 124 limousines outside the conference stop idling their motors.

These 124 gas-guzzlers were needed, of course, to bring the seven leaders and their respective entourages to the meeting. And why did they have their motors running? Perhaps to facilitate a quick getaway in case of terrorist attack?

Nope. Something much more pragmatic — to power the air conditioning!

Tandy turn on

In the August edition of the phenomenally-popular DREGS page, which is sweeping the entire continent in an outburst of DREGSmania (steady on — Ed), we published a photo of an all-American (presumably) family musing on how to turn on a TRS-80. Shortly after the issue hit the streets (as we say in the Journo business), we got a call from a Tandy spokesman.

In trepidation, we waited to hear what he thought of the photo. He seemed quite pleased with it — never even mentioned the libel laws — and added, "By the way, the answer is . . . there's a switch on the back". Phew!

Philips' famous frog fiasco

During a press conference to announce the release of their new video system, Philips required an off-air signal to demonstrate its capabilities. Unfortunately, the only programme being transmitted was one on the sex life of a frog — and in black and white, yet.

Those of you who are familiar with the way in which TV sets are commonly shown off at press conferences and shows — as an enormous array of screens, all showing the same picture — will be best able to appreciate the spectacle it provided.

Another similar incident occurred when a hi-fi firm showed off its latest tuner to a crowded room at a show in the UK. 'Auntie' BBC were busy transmitting a radio programme all about the feeding habits of wild birds. When the demonstrator pressed the 'on' button, the phrase 'tits like coconuts" burst forth.

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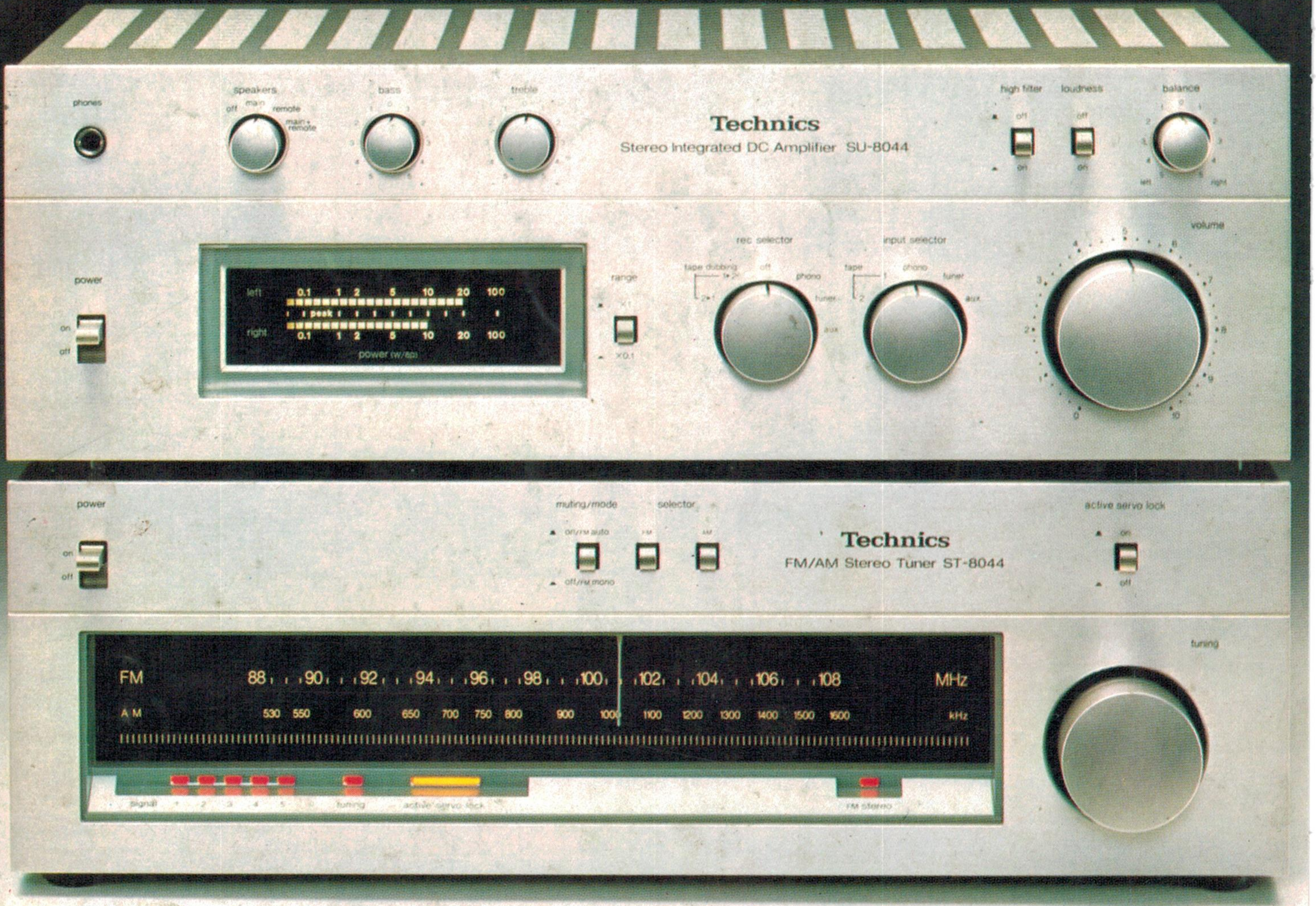

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Shown above is the SU-8044 integrated DC amplifier and ST-8044 tuner. The amplifier delivers 38 watts per channel output — plenty of power for dynamic sound.

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On the SU-8044 model highly accurate, easy-to-read FL (fluorescent) meters replace conventional needle-type meters for peak power indication.

The matching ST-8044 AM/FM Stereo tuner features five LED's to indicate signal strength in a linear progression. When all are lit then the best possible reception has been achieved. You are then able to utilise the active servo lock to eliminate frequency drift.

You can write to Technics Advisory Service for further facts and figures but the real test is listening . . . at your nearest Technics dealer.

For a National Technics catalogue, please write to:
Technics Advisory Service, P.O. Box 278, Kensington, N.S.W. 2033

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